The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

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A TECHNIC FOR FULL DENTURES AND THEIR FUNCTION IN ANATOMIC RECONSTRUCTION

By LEONIDAS F. SMITH, D.D.S., Indianapolis, Ind.

A DISCUSSION of full dentures involves consideration of the correction of a malformed mouth. Full dentures are more than just a set of teeth. Their function in masticating food is of great importance, but there is more to be considered.

In many cases, the attempt to maintain natural dentures has been prolonged over a number of years. This has frequently led to a disturbance of many associated functions, such as deformity of muscles, atrophied by malocclusion and a closed bite; wearing down of the teeth for a long period before extraction and restoration without proper correction, and mandibular joint destruction, with its effects on the ear, nose, throat and sinuses. Partial dentures have been made when only the anterior teeth remain, and thus all the pressure of mastication has been thrown on the anterior teeth and the condyle heads. Nearly 100 per cent of cases show malformation when they are presented for denture construction.

Balanced occlusion; facial restoration; esthetics, and tooth form—it is impossible to consider full denture work intelligently without touching on all these phases. There is no other problem within the scope of the profession less circumscribed or more worthy of a correct procedure.

So much has been written on the subject and so many difficult methods have been advanced that confusion has resulted. A complicated technic prevents fine results. Application of a simple technic is as necessary as knowledge. By discarding unnecessary steps, the difficult case becomes easier and the essential technic is more readily understood, and thus more men obtain adequate results, thereby distributing better service and to more people. The operator is able to produce work in which he can take pride, if he comprehends the whole subject; and if he comprehends the whole subject, the procedure is greatly simplified.

It is not necessary in this paper to go into the tissue changes that take place in the temporomandibular articulation after long closure or malocclusion. If the dentist recognizes the symptoms, and knows how to correct the condition, nothing else is essential. Frequently, the patient who is suffering from mandibular

Read at the Indiana State Dental Association Meeting, Indianapolis, May 15, 1939.

joint pathosis has no pain or apparent disturbance of the joint, and he seeks relief from some associated symptom which is really a secondary condition. James B. Costen, in a paper read before the St. Louis Medical Society, said:

The frequency of ill-fitted edentulous mouths among the middle aged, and malocclusion from all other causes in others, make the factor of mandibular joint pathology confuse the picture in diseases of contiguous structures as well as those of systemic nature. The attention of the patient is rarely drawn to the joint or mouth condition as a cause of headache or ear trouble; interest is taken in eyes, sinuses, circulatory system, nervous system and the gastro-intestinal tract as traditional explanation.

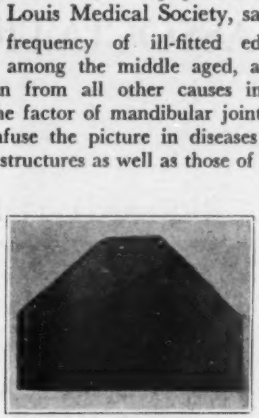

Fig. 1.—Brass plate cut to approximate shape of lower jaw.

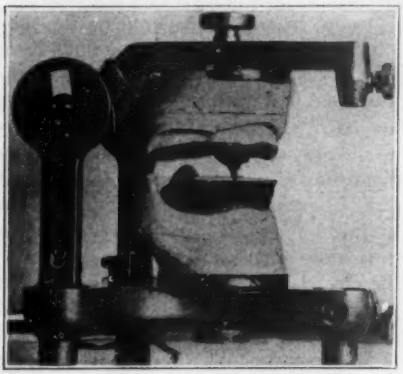

Fig. 2.—Uniform distribution of pressure, seating base-plates and condyle heads.

Extensive research into this subject was carried on at the University of Pennsylvania and the Evans Dental Institute several years ago. The report of the findings was presented in the *Dental Cosmos,* under the title "Symptomology and Treatment of Abnormalities of the Mandibular Articulation," by David J. Goodfriend, of Philadelphia. These experiments demonstrated that:

(1) Approximately 50% of all patients have some form of abnormality of the mandibular articulations.

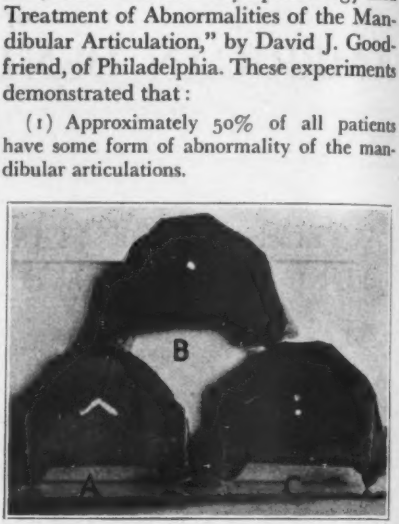

Fig. 3.—Lower bite-plate, showing: (A) Gysi gothic arch tracing; (B) depression drilled at apex, marking centric relation; (C) second depression 5 mm. posterior to first, for protrusive bite.

Fig. 4.—Upper and lower bite-plates, in centric relation and under biting stress, sealed together with quick setting plaster.

(2) 12% of this group are conscious of joint symptoms and 88% are not aware of joint diseases.

(3) The great majority of cases with mandibular joint diseases seek treatment for associated reflex symptoms.

(4) The primary complaints of patients

with mandibular joint diseases, in the order of their frequency of recognition, are: (a) deafness; (b) bite anomalies; (c) speech defects; (d) joint symptoms, as crackling and snapping of the joints; (e) ear symptoms other than deafness, as tinnitus and eczema; (f) facial deformities; (g) pyorrhea; (h) malocclusions; (differentiated from bite anomalies in-so-far as tooth irregularities were predominantly observed); (i) vertigo. 95% of the patients treated for joint diseases and 88% of the patients of the ear clinic, had abnormal mandibular joints associated with occlusal anomalies. In the fifty-one completed cases, the correction of the gnathic abnormality and the elimination of foci of infection have invariably been associated with the relief of articular symptoms.

In this final summary, Goodfriend states:

Degeneration of the mandibular articulation is caused by the loss and displacement of the masticating surfaces of the teeth through erosion, extraction, malocclusion, and improperly constructed replacements.

The treatment consists of the establishment of normal intermaxillary and condyle-eminence relationships and a balanced dental occlusion in harmony with the restored masticating mechanism.

The correction referred to by Dr. Goodfriend is accomplished by restoring the natural teeth to balanced occlusion, at the proper vertical dimension, or with full dentures in balanced occlusion and with correct vertical dimension. A closed bite drives the condyle head back, and a lack of teeth in the posterior region of the mouth drives the condyle head up. It is fortunate that restoring the vertical dimension, establishing the proper occlusal plane and balancing the occlusion overcome the temporomandibular deformities. Of course, the teeth must extend posteriorly to the normal extension of the natural teeth, well back between the masseter muscles, in order to prevent undue pressure on the condyle heads when the muscles of mastication bring the mandible into occlusion with the opposing upper teeth under biting stress. If the masseter, temporal and associated muscles contract posteriorly to the occlusion of the teeth, powerful pres-

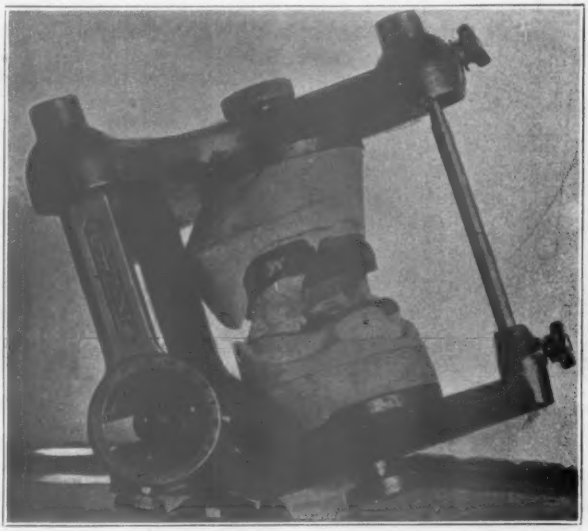

Fig. 5.—Mounting lower cast with bite-plates sealed together in centric relation.

sure will be exerted on the condyle heads, injuring the tissues in the upper portion of the glenoid fossa, and defeating all other efforts to restore normal function.

Another factor of vital moment in the protection of the tissues is the type of posterior tooth used. Too much emphasis cannot be laid on the importance of tooth form for full dentures. The anatomic tooth, which has been in general use for years, is not only contraindicated, but also is positively destructive to the bony tissue. The word "artificial" implies a substitute, and it has taken the dental profession a long time to realize that an anatomic tooth form is indicated only when the tooth is a part of the body. There is a mechanical difference between

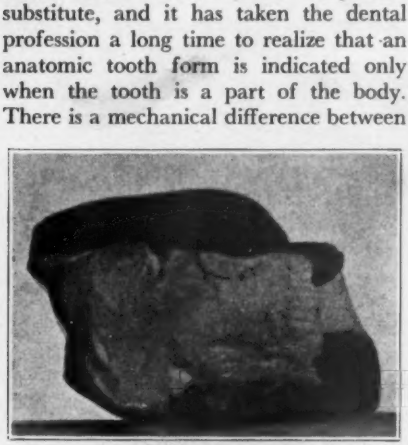

Fig. 6.—Bite-plates sealed together in protrusive relation.

a natural denture, consisting of thirty-two units fixed in the bone, and a substitute of two units retained by adhesion. It is possible to bite hard on two opposing natural teeth without disturbing the others. This is not true of artificial dentures, which must articulate in such a way that the adaptation of the dentures is not disturbed by occlusion. The natural teeth are not altered by resorption of their foundations until it is quite pronounced, and protrusion of the mandible comes only with wearing down of the occlusal surfaces of the teeth. Resorption of the underlying structure of artificial teeth is rapid in comparison, and if anatomic teeth are used, the destruction is hastened. There is no forward movement of the mandible until the vertical dimension is shortened. The natural tendency of the muscles of mastication is to retard the forward movement. As the inevitable resorption of the ridges proceeds, this forward movement takes place. Gradual closure of the mouth, due to resorption, begins as soon as the dentures are inserted. Tooth form must be such that it does not obstruct the forward movement. If the teeth are locked with cusps, something has to give to allow the mandible to move forward, and rapid deterioration of the bony ridge results.

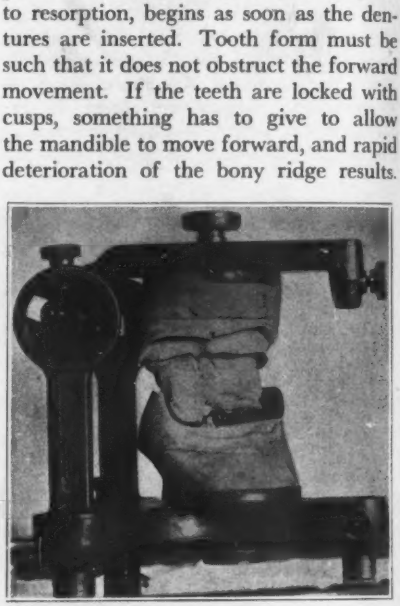

Fig. 7.—Condyle paths of articulator adjusted to protrusive bite.

The future service of the denture must be considered.

Posterior teeth must be designed so as to conform to masticatory function, regardless of any particular spacing, anteroposteriorly. The spacing of anatomic posterior teeth is predetermined by the cusps. The lateral plane of the tooth should be in accord with the angle of the condyle path. Lateral inclined planes are necessary on the upper denture, to form the curve of Spee. These inclined planes are governed by the inclination of the condyle path and must conform to it to prevent lateral movement of the denture during mastication, and to better

cut fibrous foods. A flat tooth can be used successfully only where the inclination of the condyle path is zero. When the lateral inclined plane of a tooth is parallel with the inclination of the condyle path, it is level with the movement of the jaw and will not produce trauma.

A good example of this type of tooth is the Sears channel tooth. Posterior teeth should be so designed that the anterior teeth can be set up in any desired position, with due regard to esthetics. The anterior teeth should not be in occlusion in chewing food. There should be a natural overjet and overbite. The overjet makes it necessary to reach forward to incise food, and the overbite takes the molar teeth out of occlusion and makes it possible to incise food. This arrangement also removes the inferior-

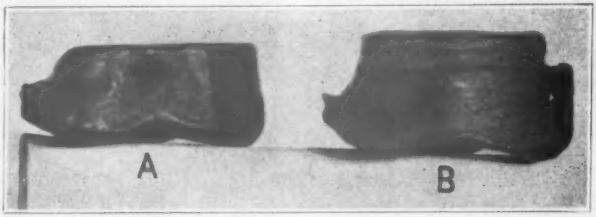

Fig. 8.—Appearance of bite-rim when removed from mouth (A), and after adding small roll of wax to inner portion of occlusal surface (B).

anterior teeth from the lifting action of the lower lip. To compensate for an overbite, the second molars should be tilted on both sides to equal the depth of the overbite, and adjusted to maintain the curve of Spee.

The occlusal plane is a part of the jaw structure and cannot be changed by the operator. It is to be found, not created. The occlusal plane is governed by the inclination of the condyle paths. The mandible, suspended and operated by the muscles of mastication, swings in its excursion according to the movement of the condyle heads on their paths, establishing the occlusal plane. Artificial teeth must be set up and adjusted to conform to this natural occlusal plane. Balanced occlusion must function on this plane.

If a deformity has existed, and dentures have been supplied to make the needed corrections, the gradual return to normal conditions may later necessitate new dentures. Centric relation may change, owing to correction of mandibular joint conditions, allowing the condyle head to seat itself properly in the glenoid fossa. If long unilateral mastication has existed, the Gysi gothic arch may register on one side only. This condition will be corrected by balancing the occlusion, and normal action will be restored on the affected side. This may change the balance of the occlusion, through restoring the condyle path. If trouble develops from these changes, balanced occlusion must be restored by resetting the teeth with a new bite. Dentures do not change, but tissues do. Such changes do not mean that the dentures have failed, but that Nature has corrected a deformity. The dentist cannot be held responsible if new dentures are required as a result of such correction.

The same dentures should not be worn over a long period of years. Resorption will destroy proper function. This is more rapid in some persons than in others. A check-up of all denture cases should be made at intervals. No attempt at rebasing or relining should be made as there is no way to do either.

Opening the bite is the first step in facial restoration. The buccal tissues do not rest on the teeth: they are supported

by the bony structure of the face, the zygomatic ridge and malar bone above and the lower margin of the mandible below. A closed bite folds these tissues and distorts them, adding years to the appearance. Opening the bite restores the natural position and improves the appearance. The anterior teeth support the lips, which, if properly contoured, supply the remedy.

Opening the bite at one operation, or by degrees, is a controversial question. Some operators think that it can be done better by several restorations, opening the bite a little at a time. Others would complete the work at once. The question

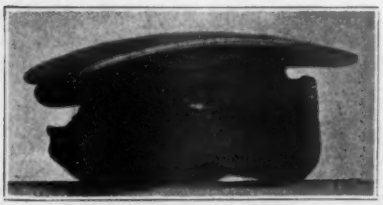

Fig. 9.—Template in position before melting roll of wax.

Fig. 10.—Wax melted down to form an approximate curve of Spee.

of expense may alter the case because of the difficulty of paying for several operations.

The most satisfactory procedure is to complete the opening of the bite at one operation and make necessary adjustments afterward. There is only one place for the condyle head to function. If the bite is open to the proper vertical dimension, the head of the condyle will rest in that position more readily than if the adjustment is by degrees, and the possibility of the patient's failure to return for further correction does not need to be considered.

Opening of the bite is subject to the judgment of the operator, and a thorough knowledge of the underlying structure is necessary. The patient can give no assistance. Trying to determine the proper vertical dimension by directing the patient to take rest position, after his bite has been closed for years and the lips and muscles are shortened by long closure, is futile. The rest position depends on the existing bite, regardless of its correctness. A new rest position will be developed after increase of the vertical dimension. Observation and measurements of the portions of the face, which do not change, afford a basis for the needed corrections. First we must measure from the glabella to the base of the nose and compare this distance with that from the base of the nose to the lower portion of the mandible at the symphysis; then measure from the tragus to the external canthus and from the external canthus to the corner of the mouth. These measurements are nearly always equal. The operator's judgment can be relied on for the remainder of the determinations.

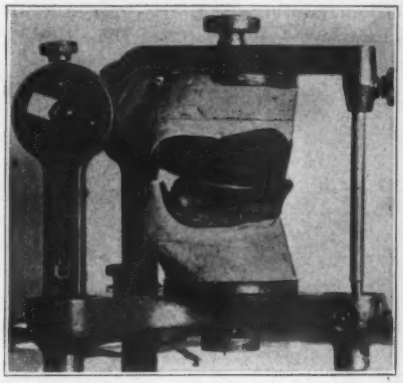

Fig. 11.—Articulator closed on soft roll of wax on lower base-plate.

During the adjustment of the condyle

head in the glenoid fossa, the deformity of the muscles of mastication is being corrected; the facial deformities are being overcome, and biting strength is being restored. It is an advantage to adjust all of these factors in normal function as soon as possible. The only contraindication is an unfavorable mental attitude of the patient on account of the marked change in facial expression.

The esthetics of full dentures should be considered in everything that is done from the moment the patient seeks treatment. A person wearing dentures cannot look natural if uncomfortable. Poor judgment, or a mistake anywhere along the chain of links which make up the completed case, will defeat all efforts at improving the appearance.

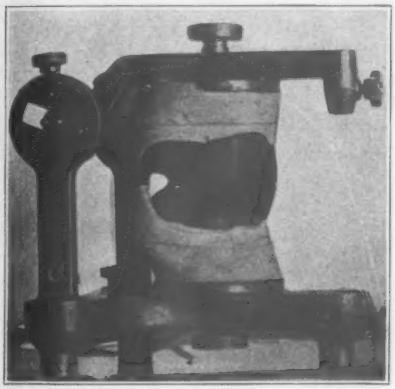

Fig. 12.—Bite ridges with approximate curve of Spee established.

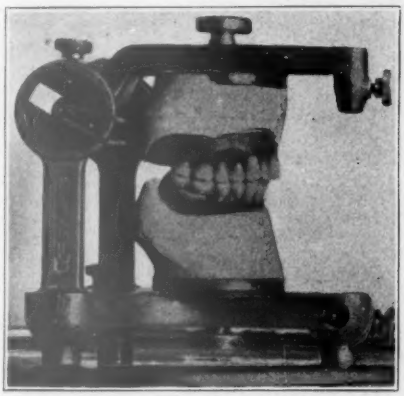

Fig. 13.—Completed set-up, showing overjet and overbite. The second molar is tilted to compensate for the overbite.

Proper diagnosis; surgical preparation where needed; a 100 per cent impression; a bite which will afford the necessary interocclusal space after adjustments are made; careful selection of teeth, considering mold and shade and including a natural variation of shade to break the monotony; observation of all fixed rules for setting up the teeth and rearrangement to suit any individual peculiarities; attention to interdental space, contour, reflections, shadow effects and irregularities that may appear natural; the use of low-fusing stains; all these combine to create a natural, normal appearance in the patient. The ideal artificial denture is one which does not suggest artificiality.

It is impossible to produce a case which is correct artistically when first completed. The ability to visualize it in a few weeks or months, after tissue adjustments have taken place, is a matter of experience. Lengthening of lips, changing of muscles and settling of the dentures into the tissues complete the case and assure the desired result.

Controlling the patient's mental attitude during this trying period is a part of the technic. If the dentist knows what he is doing and feels his responsibility, his confidence will be imparted to the patient, who will then cooperate to the best of his ability. I have seen women weep at their changed appearance when dentures embodying needed corrections were inserted. In a few weeks or months, when tissue changes had taken place, these patients were afraid to have slight adjustments made for fear these might change their improved appearance.

The technic for taking the bite is relatively simple and embodies only fundamental principles. If the reason for each

step is fixed firmly in the dentist's mind, he can follow it through, step by step, in a short time. No expensive new outfit is necessary. A substantial articulator with adjustable condyle paths, facebow, adaptable base-plate material, a brass plate (about 20 gage) and a stove bolt 1 by ⅛ inch with nut attached are needed. (Fig. 1.) Hoop brass can be purchased in long strips and cut to fit the case. A piece of brass is cut to conform to the shape of the lower jaw, attached to the lower base-plate with modeling compound and leveled to the occlusal plane and about the height of the lower teeth. The head is cut from the stove bolt and the remaining screw, cut to proper length for the case, is attached to the palate of the upper base-plate with modeling compound, well forward in the bicuspid region, with the nut close to the surface and the end of the screw close against the palate. The outer end of screw is ground round and smooth, so it will mark the brass plate without scratching. The entire upper bite-plate should be reinforced with a thin layer of modeling compound, to make it rigid.

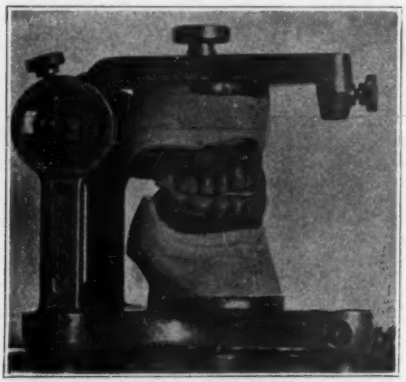

Fig. 14.—Teeth in protrusion; relation of molars and incisors when protruding.

To open the bite, the upper and lower bite-plates are placed in the mouth and the screw is turned out or in, to establish the correct vertical relation. The patient is directed to move the mandible in all possible directions under biting stress, to establish the Gysi gothic arch, the apex of which is centric relation. (Fig. 3A.) The lower bite plate is removed and, with a No. 8 bur, a depression is drilled to a depth of about one-half the diameter of the bur, at the apex of the triangle. (Fig. 3B.) The bite-plate is replaced in the mouth and the patient instructed to "open" and "close," while the condyle head is located in the closed position of the mandible. The condyle heads are marked with a soft lead pencil. The upper base-plate is removed and the bite fork of the facebow attached to the base-plate with wax. The upper base-plate is returned to the mouth, and while patient is biting in centric relation, the facebow is attached, with the ends on the pencil marks. Care is observed not to draw the skin out of its natural position over the condyle heads. While the patient is biting hard, the facebow is fastened together. Next the upper cast is removed and mounted with the facebow. It is of the utmost importance to use the facebow in order to locate the cast in the same relation

Fig. 15.—Patient whose bite was closed, owing to resorption.

to the condyle heads on the articulator as in the mouth. A cast mounted in this manner is very seldom level on the articulator, or straight postero-anteriorly. If the cast is mounted by guess, an occlusal plane built on the articulator will not function in the mouth. The next step is to remove the facebow from the case and replace the bite-plates in the mouth. While the jaws are in centric relation and under biting stress, the bite-plates are sealed together with quick-setting plaster, mixed thick. (Fig. 4.) As soon as the plaster is set, the bite-plates are removed and the lower cast mounted with the bite in centric relation. (Fig. 5.) Now both

Fig. 16.—Patient whose bite was closed, owing to resorption.

casts are mounted on the articulator in proper relation. The bite-plates are separated and another depression is drilled in the brass plate 5 mm. posterior to centric relation on the median line, by bisecting the Gysi gothic arch. (Fig. 3C.) The bite-plates are replaced in the mouth and, with the screw resting in this second depression, sealed with plaster under biting stress. (Fig. 6.) This brings both condyle heads forward 5 mm. with one bite and registers the condyle paths. The bite-plates are removed and the seal strengthened with hot wax, and plaster is added to reinforce the bite-plates at the tuberosity, in order to prevent springing. This bite-plate is attached to the lower cast with wax. The so-called incisal guide pin is removed and, by moving the condyle paths of the articulator up and down, the casts are seated in this bite. (Fig. 7.) Notches cut at the median line of the bite-plates enable one to see when the casts are seated. It is imperative that the casts be accurately seated in these bites at each step. The only function of the protrusive bite is to set the condyle paths on

Fig. 17.—Appearance after bite was opened more than one-half inch.

the articulator. The screws should be tightened carefully to prevent movement.

Up to this point, there are no bite ridges used. Now, on the second upper base-plate, we build the upper bite-ridge, and get the contour, lip-line, median line, length of teeth, etc., as we have always done. (Fig. 8A.) We cannot build the lower bite-ridge in the mouth. We already have the intermaxillary space registered on the articulator. Next, we cut a quarter of an inch from the head ends

of three ordinary pins, placing one in the wax at the outer margin of the occlusal plane of the bite-ridge at the median line, and one at the extreme posterior outer margin on each side. A soft roll of wax is attached to the lingual half of the occlusal surface of the upper bite-ridge. (Fig. 8B.) A hot template is used to melt this roll of wax (Fig. 9) and form an approximate curve of Spee. Care is observed not to disturb the outer periphery of the occlusal plane. The pins, properly placed, will serve as a guide. (Fig. 10.) This bite-ridge is chilled, the occlusal plane coated with vaseline and, with the guide-pin of the articulator in place, the bite-plates are closed on a soft roll of wax placed on the lower baseplate in the articulator. (Fig. 11.) The excess is trimmed away and we have both bite-ridges on the articulator with an approximate curve of Spee established. (Fig. 12.)

The incisal guide-pin of the articulator is used only to maintain the intermaxillary space and has nothing to do with the occlusal plane. It should now be removed and replaced only at intervals to check the intermaxillary space, which must be maintained throughout. The occlusal plane is the guide for setting up the teeth. If the inclination of both condyle paths is plus 20 degrees, we can set up the teeth and be correct. Any variation from 20 degrees in the inclination of either condyle path must be compensated for by trimming off and adding wax as necessary.

The upper anterior teeth are set up as they appear best. The upper posterior teeth are set up by removing wax sufficient for one tooth at a time and setting the tooth to conform to the already established occlusal plane, by closing the articulator with the tooth in place against the lower bite-ridge. Of course, teeth must be set well over the ridge. Next, we set the lower anterior teeth where desired, with proper overjet and overbite, and set the lower posterior teeth to the upper teeth. (Fig. 13.) If one condyle path is steeper than the other, the lateral inclined planes of the posterior teeth on that side will have to be greater than on the other. The articulation of the teeth is now regulated until every fine adjustment is completed and so that occlusion in all possible positions is a fact. (Fig. 14.) If thermal change is avoided until the investment is completed, the case will need no further grinding or milling to make it fit.

The majority of changes that take place in vulcanizing or pressing dentures are wax changes rather than changes from displacements in the plaster. Care should be observed to maintain room temperature at all times, and room temperature plaster and water should be used for investment. It is well to check the occlusion carefully just before flasking to see that no wax changes have taken place.

The accuracy and simplicity of this technic will repay one for the time spent in mastering it. Every step except determining the vertical dimension is almost automatic. Any technic with successive steps must be accurate at each step or failure will result. Accurate impressions, correct vertical dimension, transfer of casts to the articulator with the facebow, taking of all bites under biting stress, seating the casts accurately in the baseplates while mounting, correctly registering the condyle paths on the articulator and carefully working out the occlusal planes are necessary. Careful attention to all these details will result in better full dentures.

809 Chamber of Commerce Building.

CONTROL OF PAIN IN OPERATIVE PROCEDURES

By L. W. Thom, D.D.S., Minneapolis, Minn.

PAIN is an acknowledged symptom of many diseases. Because we, as dentists, inflict pain in the treatment of dental disease, it is necessary to fully appreciate its importance.

Richard Behan has given us the following definition of pain: "Pain is distinctly a mental interpretation and cannot be strictly defined. It is the interpretation of some abnormal and generally harmful process which is occurring in the organisms."

To be normal, the whole nervous system, which includes the sense-conveying organs, the sense-interpreting centers and the associative memory (consciousness), must be active and intact. If consciousness is disturbed by certain mental diseases or anesthesia, the sensory stimuli either will fail to be perceived or will be greatly modified.

Consciousness has been divided into two classes: (a) subjective, and (b) objective. Subjective consciousness informs us of things which originate in the mind; objective consciousness informs us of things noted through the senses.

Sensation, which is a perception of an impression conveyed to the brain as a result of a stimulus to the peripheral sense organ, possesses the property of quality, intensity and duration. The stimulus necessary to produce a sensation may be mechanical, chemical, thermal or electrical. When any one of these types is applied in normal quantity and with normal force, a normal reaction is the result. However, when applied with excessive intensity, all are capable of causing pain. It is evident, then, that the dentist must be concerned with the nervous system as a whole, and with its reactions to stimuli in operative procedures.

Let us now consider the influences which may be utilized to control the painful and unpleasant reactions which may be produced in operative procedures. A psychic and an operative phase must be discussed.

Articles written about the control of pain in dental operations impress me with the fact that pain is often confused with unpleasant sensations. From the patient's standpoint, dentistry has not eliminated the unpleasant sensations sufficiently to make a dental appointment something to be enjoyed. Even though pain control has advanced to its present state of near perfection, you and I still dislike an operation on our body. Our treatment of a patient must be so completely controlled and executed that the pain, plus unpleasant sensations, is reduced to a minimum.

Sensitivity to pain is not limited to one group or class of individuals. Environment, education and various types of endeavor may influence one group more than it does another, but my personal experience has convinced me that each individual is a problem in himself, and a knowledge of the fact that he is rich or poor, cultured or uncouth, educated or uneducated, will not materially help the dentist in selecting the proper type of treatment. In fact, it is possible that the individual patient may require one type of treatment at one time and a different type at another. This is usually due to changes in one's physical

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and mental condition. It is essential that the dentist fit his treatment to the temperament of the individual patient at the time of the operation. That requires the application of psychology and common sense.

A smart football coach does not treat all the men on his squad alike. James Crowley, coach of the Fordham football team, once said, "Machinery will respond perfectly to the touch of the man at the controls, but a football player has more angles to him than one could find in a geometry textbook. No two boys can be placed in the same category and, to get the maximum out of each, the coach has to be a keen student of human nature." We are not molding football teams, but we do want to render the best health service and in a way that will be the most acceptable to every patient. The dentist, therefore, must be a keen student of human nature.

PSYCHIC FACTORS INVOLVED IN PAIN CONTROL

The problems before the dentist when a patient presents himself for operative treatment are:

1. The creation of a favorable environment, so that a favorable impression will be made on the objective consciousness.

2. The elimination of the unfavorable phases of subjective consciousness due to imagination or the memory of a former unpleasant experience which exhibits itself in the form of fear and apprehension.

After the confidence of the patient has been temporarily gained, to the extent that he feels every care will be exercised for his comfort (in other words, he is relaxed as much as possible), everything must be done to merit that confidence.

The dentist who desires to develop his service to the peak of his capabilities must consider psychology, anesthesia, equipment, drugs, methods of operative procedure and instruments in order that his operations may be performed with the minimum of discomfort consistent with rendering the best health service. Consideration of all of the details in patient management is necessary to reduce pain to a minimum. Thought must be given to fear of pain, actual pain and unpleasant sensations.

First, let us consider the creation of a favorable environment in which to receive people who come in for operative service, so that the objective consciousness may receive a favorable impression.

First impressions are usually quite definite, and, if unfavorable, are often hard to overcome. The office should be planned to please the type of persons served. This is not difficult for dentists whose patients come from one or two classes of society. The office that receives patients from all walks of life must be planned to appeal to human nature generally.

The person who is suffering pain, or apprehending it, is often easily irritated, because, as pleasant sensations bring pleasure, so unpleasant ones result in anger, irritability and an unfavorable mental attitude. The office can and should be designed to receive people who are in mental or physical distress. It should radiate a cheerful atmosphere. The reception room need not be expensively or lavishly furnished. By the use of information gained in the study of interior decorating, furniture, furnishings, lights and colors can be so selected and placed that the total will be in complete harmony and will please the people who enter. Pictures may be used to suggest pleasant thoughts. The power of suggestion is most effective, so let us make use of it in the reception rooms.

The operating room need not be equipped with the most expensive, elaborate and up-to-the-minute equipment, but what we have should be simple in design, in perfect working order and decorated in a pleasing color. Proper

color combinations radiate a restful atmosphere. The porcelain ware, nickel plating and fittings must be spotless, giving the patient a feeling of security as far as cleanliness is concerned. Even though the equipment is old, it need not and must not look shabby or neglected. People are not concerned nearly so much about the model or year of furnishings as they are about the general appearance. George Wood Clapp has said,

> The operating room is often hideously overequipped. Some operating rooms look like a section from a scientific laboratory or an inquisition room. It may make us feel proud to look about on all the apparatus we have collected and feel that we know what every tube and lamp and appliance means and that we can use them all, but the patient's viewpoint is often very different. Each tube and cord and appliance is a mysterious engine to be used on him, and most of them cause pain.

The pleasing countenances of the dentist and his assistant, together with their correct general appearance, complete the picture which we hope will have the desired psychic effect.

Now we come to the second problem, namely, the elimination of the unfavorable phases of subjective consciousness due to imagination or the memory of a former unpleasant experience, which exhibits itself in the form of fear and apprehension.

Mental activity may be divided into three divisions: (1) intellect, which is the faculty of thought; (2) sensibility, which is the faculty of feeling, and (3) volition, which is the faculty of voluntary action. We are primarily interested in the second division (sensibility), but it is closely associated with intellect. Intellect can, by the use of memory, remember and magnify objective sensations classed as pain and unpleasant sensations, and make them appear real, as if experienced at the time. How often have you had a patient come to your office with this remark: "I was badly and, I think, unnecessarily hurt and frightened in early life by a painful operation." Naturally, it is difficult for the patient to completely overcome that experience.

Appropriate remarks by the dentist, or his assistant, will aid materially in gaining the confidence of the patient and allaying his fears. People of different economic levels, of various social circles and of various ages each require certain types of conversation. Often they can be placed at ease with the proper approach. The dentist and the dental assistant of today cannot perform their duties without an understanding of human interests. They should be familiar with a sympathetic approach to the problem at hand. Every move must personify a business-like, well-regulated and systematic procedure.

Every professional man must have certain attributes which attract and help him to gain the confidence of people. Some men have more than others. Those who are less gifted must cultivate the good traits in which they are deficient and possibly discipline their mental attitudes so that they may be able to partially overcome an unfavorable phase of subjective consciousness. Mathew N. Chappell, Ph.D., once said, "Everyone inherits two fears—fear of sudden loud sounds, and fear of loss of support. Every other fear is learned, and these will be forgotten unless they are reviewed or practiced occasionally." For the patient who fears a dental appointment, it is well to remember that treatment before and during the operation must be such that it will gain his confidence, thereby helping him to forget his fear.

Thus far I have dealt with a "build up" of the mental attitude of the patient in order that he may be relaxed to the utmost. Everything has been done as far as furnishings, equipment and approach are concerned to make a favorable impression on the objective consciousness and to bolster the subjective conscious-

ness, thereby attempting to break down any memory of an unpleasant experience. With the patient in as nearly the proper mood as possible to receive operative service which will include unpleasant sensations and possible pain, we are now ready to perform the necessary operation. I believe this psychic treatment is necessary because it does require courage to be subjected to surgical procedure.

METHODS USED TO CONTROL PHYSICAL PAIN

From this point, we are primarily interested in the control of physical pain, but, in order to accomplish that as nearly as possible, some psychic treatment is also necessary. Even though an anesthetic has completely blocked pain, a sympathetic attitude is necessary to help the patient tolerate some of the disagreeable sensations accompanying a dental operation.

Generally speaking, operative work may be performed (1) without an injected anesthetic; (2) with an injected anesthetic; (3) with the aid of analgesia, or (4) with the aid of premedication.

From information that I have been able to gather, it seems that many operations in operative dentistry are still done without the aid of an injected anesthetic or analgesic, and properly so. A portion of an article which appeared in *Life Magazine,* January 16, 1939, reads: "Finally your best hope is that your dentist will, as all dentists should, use anesthetics for even minor operations. For thus only can the dentist make the patient feel that dental care is worthwhile." If operative procedure is included in this rather sweeping statement, I cannot agree with the writer because I believe that there are cases wherein an anesthetic is not indicated. Many patients because of either lack of fear of the operation or lack of sensitivity, or fear or dislike of an injection or of analgesia, prefer the work to be done this way. By utilizing known methods of procedure, dentin anesthesia and mental therapy, we are able to operate on this group successfully.

The two main factors in the pain are: (1) the fact that the tooth contains sensitive areas which must be cut, and (2) the fact that the tooth is sensitive to thermal change.

The most sensitive parts of the tooth, according to Charles F. Bodecker, are (1) the pulp, (2) the dentino-enamel junction, (3) the granular layer of Tomes and (4) the interglobular spaces in the dentin. Needless to say, it is necessary to know the anatomy of the parts that we are operating upon. In operative procedure, where the pulp is vital and not involved, we are most interested in the dentino-enamel junction. Dr. Bodecker's theory is that the dentinal tubules are channels in the dentin conveying the protoplasm fibrils of the odontoblasts to the pulp. Just before they reach the dentino-enamel junction, these fibrils split into many branches, saturating this area with peripheral sense organs. Naturally, when a bur strikes this area, pain results. Whether or not this theory is correct, we know definitely from practical experience that this is a very sensitive area. In cavity preparation, it is necessary to cut through this area. Dr. Bodecker recommends that the dentin below the dentino-enamel junction be undermined to the desired extent with an inverted cone bur, and thus the lines of communication be cut off so that the isolated area is not sensitive. A chisel, hatchet or stone may now be used to remove this overhanging tooth substance. However, if the procedure is reversed, and the outline form is produced and gradually deepened to the desired depth, the cutting will be painful all the way.

Thermal sensitiveness causes a great deal of pain unless controlled by the dentist. Sudden, extreme or prolonged changes of temperature will cause pain. Permitting stones, disks or burs to revolve too fast or using them too long without a warm spray of water on the tooth or

a stream on the cutting surface will cause unpleasant thermal sensations and pain in cavity preparation. Air in chip blowers and in air syringes should be warm, and water syringed into open cavities must be of the right temperature.

Cement improperly mixed on a slab of the wrong temperature will generate heat while setting and cause pain for the patient. The use of a correct mix as recommended by the manufacturer, and prepared on a slab which has been cooled to from 65 to 75° F., will avoid this discomfort.

When metal restorations are tried into sensitive cavities, they can, with a moment's effort, be brought to a comfortable temperature before insertion.

Base-plate gutta-percha, one of the best temporary fillings, is often carelessly placed in a sensitive cavity before it has been allowed to cool to near mouth temperature. If it is properly manipulated, no pain need accompany its placement.

Metals which are used to restore lost parts of teeth are conductors of heat and cold. A cement base in the deep portions of the cavity will break that conductivity.

The use of uneven rough stones, dull and large burs revolving rapidly, bent mandrels, chattering handpieces and dental engines causes unnecessary pain and discomfort. At best, this equipment produces unpleasant sensations. Bissell B. Palmer says,

> Another factor that sharpens fear is that the roots of a tooth are embedded in bone—bone of a jaw. Consequently, each manual disturbance or vibration of the teeth is transmitted to these bones and, by conduction, directly to the skull surrounding the brain. Moreover, sounds emanating from dental procedures become amplified, owing to the proximity of the organs of hearing, and increase fear of patients, even when no pain is involved. This mental condition indicates the important rôle of imagination and anticipated anguish in the production of dental fear.

A dentist who uses equipment which vibrates cannot prepare cavities in teeth with precision, nor can he avoid abusing his patient.

There are complications in many operative procedures. Often clamps, rubber dam and other accessories must be used. When they are necessary, their manipulation must be such that they may be applied with the least discomfort to the patient. The more complicated the operation becomes, the greater the effort must be to perform skilfully all of the details of the operation. Clumsy operating causes much unnecessary pain. The rubber dam can, if skilfully applied, be placed without pain. Clamps can be placed painlessly by careful procedure and with surface anesthesia of the gum.

With the rubber dam in position to protect the soft tissues of the mouth, dentin anesthesia can also be used as recommended by Hartman. Much has been written about this procedure. Some writers have recommended it, but, on the whole, reports have been unfavorable. There is a place for this type of anesthesia. I have had many beneficial results from the use of Hartman's solution, and I feel that its unpopularity is quite largely due to a lack of willingness on the part of dentists to apply it properly. Many sensitive areas can be comfortably prepared when dentin anesthesia is used.

The proper use of sharp-cutting instruments causes less pain, in most instances, than the use of the bur, when a choice between the two can be made. Heat is not generated by them and they do not vibrate. With the aid of the bur to undermine the enamel, the cavity can be quickly formed with a minimum of discomfort. Too many dentists have forsaken the cutting instruments for stones and burs, and are overlooking a method of cavity preparation which is effective and quickly performed.

When burs are used, they should be sharp and not too large. When a tooth is wet, burs will clog with saliva and tooth shavings. Because of this clogging,

the bur, even though it is sharp, will not cut rapidly. In fact, its action will resemble that of a dull bur, generating undue heat. Burs can be used advantageously to enter cavities either through a break in the enamel or a groove undermining the enamel so that the cutting instruments can be used to eliminate the overhanging enamel. The approximate outline form can thus be formed.

Decayed or disintegrated dentin should be removed with excavators. These instruments do not cut sound dentin, which is a safeguard against accidental exposure of the pulp. In using a bur, it is less painful to start cutting in an area which is not sensitive, directing the bur toward and through the more sensitive portion. A dentin anesthesia or mental therapy, or both, may be used in cutting through the latter section of the tooth. A pull cut usually causes less pain than pushing the bur. I believe most of us "bear down" on the bur far too much, thinking it hastens the cutting. As a matter of fact, the operation is retarded. The handpiece should be held firmly, but the bur should be allowed to touch the surface very lightly, and to cut without other than a guiding motion.

Drugs, such as eugenol, phenol and silver nitrate, are used to lessen pain in operative procedures. Eugenol may be applied to the dentin prior to placing a temporary filling, such as base-plate gutta-percha. At the following appointment, the exposed dentin will be less sensitive. Phenol dried into dentin will reduce the sensitiveness. Silver nitrate may be used similarly in the molar region, but, because of its discoloring effect, its use is inadvisable in anterior teeth.

I believe the following method of tooth cutting causes a minimum of pain, and at the same time is practical and efficient. It is presented, not with the idea that it is the only method, but in the belief that it deserves consideration. The following method is not original. It is used by dentists who, I believe, are excellent operators.

Let us consider decay on the mesial-proximal surface of a bicuspid, where the marginal ridge is still intact. A No. 557 fissure bur is placed, slightly tilted, in a groove just inside the mesial marginal ridge and directly over the cavity. When the bur reaches the decay, it is straightened so that the cuts will be made parallel with the lines of the cavity. The cut is made just inside the dentino-enamel junction, thereby missing a more sensitive area, and is far enough from the adjacent tooth not to damage it. After the bur is straightened, it is directed below the decay to the correct location of the gingival seat and then guided buccolingually, thereby establishing the gingival wall and the axial wall and undermining the buccal and lingual enamel.

A chisel properly directed will cleave the undermined enamel, approximately establishing the buccal and lingual walls. A No. 556 fissure bur is placed in the distal groove, slightly tilted and directed to the proper depth of the pulpal wall. The bur is then straightened, and directed buccolingually, thereby forming the distoclusal wall and the distal portion of the dovetail. This bur is used to avoid undercutting the distomarginal ridge. A medium-size inverted cone bur is placed in this excavation so that its cut will give the proper depth of the pulpal wall and is guided toward the axial portion following the groove.

A chisel is used to remove the weakened enamel, forming the approximate occlusal outline. If decay remains, it is removed with an excavator and a cement base is inserted. From this point, the basic cavity can be completed for a gold foil filling, an inlay or an amalgam filling. This method can be used routinely with or without anesthesia or analgesia. Heat generated by the bur must be controlled to reduce pain and avoid trauma to the pulp.

With patients who fear pain or who

have hypersensitive dentin, a local anesthetic or analgesic may be used. I shall confine my remarks to the injected anesthetics. Slow injection, with most of the preparations, does not seem to upset the patient at the time. Technics for the various injections have been perfected so that every tooth in the mouth can be anesthetized sufficiently for operative procedure. Much improvement has been noted in the solutions used for injection. Reference to reports of the Council on Dental Therapeutics will aid in the selection of the preparation best suited for the work.

When injections are made, the needle should be sharp, and the area to be punctured should be anesthetized on the surface or topically. This will minimize the discomfort of the injection. Care must be taken not to work too rapidly on anesthetized teeth. The heat generated cannot be felt, and the pulp may be injured.

Obstacles in the way of recognizing this method as the only way to abolish pain in operative dentistry are: occasional pulp exposures which are not noticed; postoperative disturbances; dislike or fear of this type of anesthesia by some people, and unfavorable reactions at the time of injection. When it is suitable and is correctly administered, however, it is an effective and practical method of handling these cases, and I do not hesitate to use it.

For those persons who object to an injected anesthetic or who react unfavorably, and who fear the pain occasioned by hypersensitiveness of the dentin, analgesia may be used. Recently, machines dispensing nitrous oxide and oxygen have been introduced to enable dentists to produce analgesia. Those who use them believe that they are an aid in their work. Only time will tell whether this method of pain control will be universally accepted. Nitrous oxide analgesia is not new. This method of pain control has had supporters for some years. However, up to the present time at least, it has not appealed to the majority. The manufacturers of the apparatus have made improvements and have refined the machine so that it is less cumbersome and interferes very little with the operator.

S. M. Frank writes:

> Analgesia means the absence of sensibility to pain or a condition in which pain-producing stimuli are inhibited without loss of consciousness, a state in which the patient knows what is going on and may respond to directions from the anesthetist and the operator. . . . Analgesia is based on the phenomenon that the first sense to surrender under nitrous oxide and oxygen administration is the sense of feeling (pain), leaving the other special senses less influenced but influenced nevertheless. Loss of consciousness is considered the dividing line between anesthesia and analgesia, but one merges so gradually into the other that, when the patient's eyes are closed, it is impossible to determine without first testing the reflexes, the exact moment when consciousness is lost. For this reason, the patient should be instructed to keep the eyes open at all times and to try not to fall asleep.

Nitrous oxide and oxygen may be administered by a well-trained anesthetist whose duty it is to keep the patient in an analgesic state. This is rather difficult at times because, as Dr. Frank has stated, the patient merges gradually into anesthesia. By this method, however, the dentist may delegate the responsibility of analgesia administration to the assistant, and concentrate on the operative work. It is obvious that the assistant must be an expert anesthetist.

Nitrous oxide may also be administered by the patient. In this procedure, the machine is set to a maximum amount of nitrous oxide which the patient may inhale. As the patient feels pain, he presses a bulb. If he should pass into anesthesia, he will not squeeze the bulb. If the dentist wishes to bring the patient out of analgesia or anesthesia, he may do so by opening the valve of the oxygen tank. Most of the machines that I have seen

in dental offices have this equipment for patient administration.

Patients require various quantities of nitrous oxide for desensitization. Some require very little; others require considerably more. Some persons hesitate to inhale enough to place them into an analgesic state, because they become alarmed when some of the symptoms of analgesia appear.

When nitrous oxide and oxygen are self-administered, it is difficult for the dentist to give his undivided attention to his operative work. He must keep a watchful eye on the patient, who may be in or out of the analgesic stage or verging on anesthesia.

Dr. Frank writes: "Nor will analgesia miraculously transform a hysterical patient into a calm one unless the anesthetist can first secure that cooperation which comes with confidence in the dentist." In this connection, J. M. Shultis reports: "Successful analgesia is 50 per cent analgesia and 50 per cent psychology."

However, for operative procedures, the patient control method is, I believe, the one to be recommended. The machine is set so that the patient will not be able to inhale too much nitrous oxide, and he is the judge of his analgesic condition.

There is, no doubt, a group of patients who can use this form of pain control. With the machine set at a safe limit, they may keep themselves in the proper analgesic state and fear the dental operation less. As in the case of the other methods of pain control, however, analgesia cannot be used routinely.

Discussing contraindications for analgesia, Dr. Shultis states:

> Asthma patients who are known to have asthmatic spasms should be treated with precaution. We know of such patients who have had it administered successfully. Incidentally, for the relief of any of your patients suffering from such spasms, helium and oxygen on your analgesor will give relief. Patients recently recovered from pneumonia, or who have been ill, or are in a weakened condition, administer sparingly, if at all; epileptic patients, do not administer; with cardiac patients, if they are able to walk upstairs and hold the breath for twenty to thirty seconds, administer.

PREMEDICATION

Occasionally, we are required to deal with extremely nervous or neurotic patients who need premedication for a psychic as well as a systemic effect to lower the general nervous tension. The consciousness of these people is not influenced by the methods mentioned. In fact, they may or may not allow the operator to start the work, even though assured that the dentist can control the pain. They are afraid of everything about the operation, including the anesthetic. Their mental and physical condition is explained by Mathew N. Chappell:

> Fear and fighting are very much alike in some respects, and this similarity defeats attempts to control the one with the other. We are likely to regard fear as something occurring in the mind alone. Emotion is, in fact, quite as visceral as it is mental. All our internal organs increase their activity when we are afraid. Our heart speeds up, our breathing becomes labored, our throat tightens, our mouth dries, and we feel—wasn't it Robert Benchley who described it?—as if our stomach is filled with butterflies. Even the liver and glands work harder.
>
> These upheavals do not occur in the mind. Nor is this internal turmoil without biological purpose. Increased liver activity pours muscle food into the blood, the rapid heart carries it to the muscles faster, labored breathing furnishes larger quantities of oxygen and the glands pour out the chemicals required to turn the muscle-food into quick energy. Thus fear puts our body in shape to fight or run away.
>
> You can accelerate these internal activities in another way. When your wife wants you to rearrange the living room, you will require large quantities of bodily energy to move the piano and lift the sofa. By exerting effort, you speed up your internal proces-

ses to get energy—just as fear speeds them up.

And there's the joker; when we fight fear or use will-power, all we mean is that we are exerting effort. This effort stimulates still further the vital activities already speeded up by fear. It is a case of addition and multiplication. The harder one fights, the larger grows the emotion.

There are on the market remedies acceptable to the Council on Dental Therapeutics which will effectively premedicate this type of patient. They will relax him by stopping the conflict mentioned above to a point where we may begin to operate.

In Dr. McGehee's textbook, however, there is a message of caution about these premedication agents:

> A word of warning must be sounded against their indiscriminate use. The market is flooded with numerous proprietary remedies with various trade names, which are recommended indiscriminately by their manufacturers for the relief of pain in all kinds of dental and medical ailments. The danger of producing drug-forming habits through the use of these preparations cannot be too strongly emphasized. Some of these "cure alls" are dangerous and others worthless.

A patient who has been premedicated should not be allowed to leave the office unaccompanied. He is under the influence of a drug which inhibits the body processes and which lingers some time after operation. He may try to drive a car and, because of an abnormal physical and mental condition, harm himself and others.

I do not advise premedication unless absolutely necessary.

CONCLUSION

Pain control in operative procedure includes:

I. Psychic treatment: (1) by the creation of a proper environment and (2) by the special training and disciplining of the dentist and his assistant.

II. Other adjuncts of practice: (1) methods of procedure; (2) skill of the dentist; (3) preparations for injections (anesthetics); (4) equipment; (5) topical and dentin anesthetics; (6) cutting instruments; (7) medicines and drugs, and (8) analgesia, using nitrous oxide and oxygen.

It might be well for all of us to "pause and reflect" frequently to see whether we are using everything at our command to reduce pain and unpleasant sensations so that fear of the dentist may be gradually reduced. The control of pain in operative procedures does not necessarily mean its total elimination. It does mean that pain may be controlled to a point where the dentist can perform the operation successfully and at the same time leave as few unfavorable thoughts in the mind of the patient as is possible.

Our predecessors have given us a wealth of knowledge on this subject. Our confrères have contributed and are adding to this information. It is our duty as dentists to select and utilize the various methods of accepted pain control where they are indicated in order that our work may be done with less pain and discomfort, and with a finesse unequaled in the history of American dentistry. Control of pain means better cooperation; better cooperation is conducive to finer health service.

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A STUDY OF THE FACTORS IN FUSING OF DENTAL PORCELAIN, AND THE DETERMINATION OF A FUSING CHART

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A SURVEY of the data available on the firing or fusing of dental porcelain impresses one with the wide divergence in the opinions and methods advocated in this particular phase of ceramic art in dentistry.

Incidentally, these data have yielded much valuable information and will probably ultimately aid in providing a solution of this problem, which is of importance in producing the highest type of fused porcelain for dental restorations.

Among the various methods advocated, we find the slow versus the rapid increase in temperature to attain the fusing temperature designated by the manufacturer; the use of lower temperatures over a longer period of time, with or without a holding period, or of intermittent periods of increasing and holding of temperature for a definite time; time and rheostat control; synchronization of time with a clock and temperature by pyrometer, and other modifications. Probably the most extreme method is that used by certain manufacturers and in which the molded porcelain is maintained at about 1800° F. for three or four minutes and then transferred to another muffle at a temperature sufficient to complete the vitrification and glazing in from five to seven minutes.

The manufacturers of dental porcelain designate the fusing point of their porcelain, but, in most instances, leave the method of manipulation and fusing entirely in the hands of the operator. This, combined with the fact that porcelain may be fused over a longer period of time at a temperature lower than that designated by the manufacturer, has no doubt introduced a multiplicity of methods for the fusing of dental porcelain.

The purpose of this investigation was to determine a method of procedure for fusing certain commonly used dental porcelains by which the student, as well as the more experienced ceramist, could fuse dental porcelain and maintain the correct color, form, texture and maximum strength without the dangers of overfusing or underfusing and their attendant detrimental effects and the development of undesirable physical properties.

CONDENSATION

The manipulation and condensation of porcelain are so intimately related to the firing of dental porcelain that both must be done accurately and correctly to obtain glazed porcelain of maximum strength, minimum shrinkage, dense homogeneous texture, correct color and the desired translucency. By proper condensation, a dense homogeneous mass, free from hydroscopic water, with the particles of powder oriented into the closest possible relationship to one another will result. If it were possible to condense porcelain by means of enormous hydraulic pressure, the more nearly ideal product could be obtained with a shrinkage of less than 1 per cent.

Read in abstract at the General Meeting of the International Association for Dental Research, Cleveland, Ohio, March 18, 1939.

In order to mold porcelain teeth, the manufacturer or the ceramist utilizes a vegetable binder which burns out during the firing, an approximate shrinkage of from 20 to 33⅓ per cent resulting. This method, however, would not be satisfactory for making porcelain restorations since it would require molds approximately one-fifth to one-third larger than the finished tooth. (Fig. 1.)

In general practice, distilled water is used as a medium for the manipulation and condensation of porcelain powder. Water, having a low viscosity and an extremely high surface tension, provides an efficient agent for the orienting of the porcelain particles into a homogeneous mass practically free from air and hydroscopic water.

Tests show that vibrating moist porcelain into a matrix or crib and expressing the moisture gives the most satisfactory results. Unfortunately, however, it is not generally possible to use this method in porcelain restorations, and so other methods, such as vibration without a confining crib, spatulation, whipping, capillary attraction or a combination of these methods, are often employed.

For experimental purposes, three methods of condensation were used. For the first series, molds were used (Figs. 2, 3, 4) for making the facings and small slabs. The porcelain was mixed with starch and a thin solution of gum tragacanth and water, which acted as a binder.

The second series was condensed by vibration into a spoonlike mold, with the serrated handle of a porcelain instrument to vibrate the porcelain into the spoonlike facing mold. The expressed water was then removed from the surface with a linen napkin.

The third series consisted of condensing porcelain on a porcelain jacket platinum matrix developed over a metal die (Fig. 5), a combination of drawing the moisture through the porcelain by capillary attraction and also removing the water by contact with dry porcelain powder, which was then brushed off; vibration, and spatulation to mold the porcelain to the desired shape. Because the contacting teeth on the cast were of porcelain and the wire post on the die was made of 12-gage platinoid wire, held in place by a square tube in the cast, an accurate cast was provided on which the series of tests could be made.

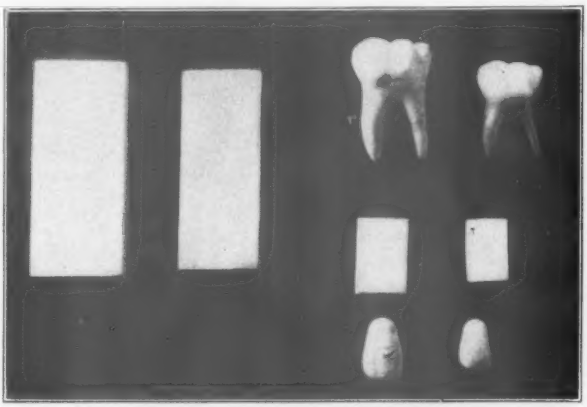

Fig. 1.—Showing the relative amount of shrinkage on slabs, porcelain teeth and facings, molded in molds, using starch and gum tragacanth for a binder.

MOLDS

To make the mold (Fig. 2), a facing approximately one-third larger than the

desired finished facing to be used for testing was embedded in wax, invested and cast, and after this half was cast and polished, the facing was placed in position and the other half of the mold was developed in wax, which was then invested and cast. The molds were cast with "K" metal, which proved very satisfactory for this purpose.

The mold for making the slabs is shown in Figure 3. It was made in the same manner, except that one-half of the mold is flat. The other half contains the form into which the plastic porcelain is molded. The sides taper slightly to facilitate removal of the porcelain from the mold after the binder has been set by heating the mold.

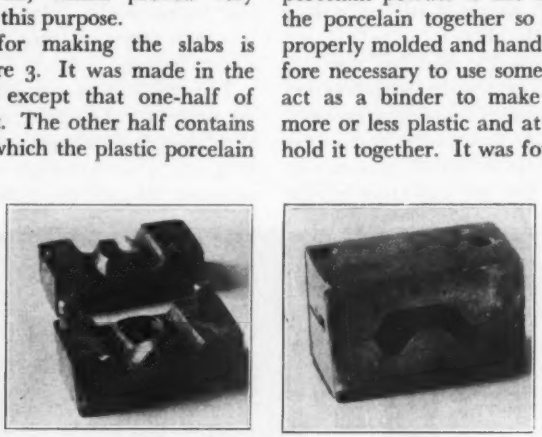

Fig. 2.—Mold for making the facings.

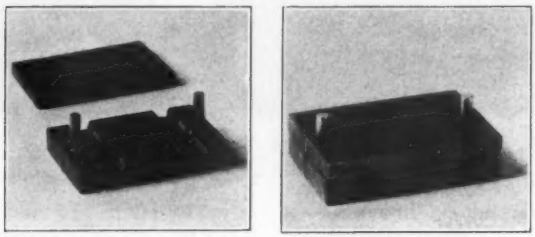

Fig. 3.—Mold for making the slabs.

The cast and die used for making the porcelain jacket crowns are illustrated in Figure 5. The cast was made of artificial stone. The porcelain teeth are the Park pinless. The die was cast of "K" metal. A 12-gage platinoid wire was soldered to the root end of the die. A square tubing which fits the wire was incorporated in the artificial stone cast so that the die could be accurately seated at all times for construction and testing purposes.

MOLDING

The addition of water to the dental porcelain powder is not enough to hold the porcelain together so that it can be properly molded and handled. It is therefore necessary to use something that will act as a binder to make the porcelain more or less plastic and at the same time hold it together. It was found that when from 3 to 4 per cent of corn starch was added to the porcelain powder and then a thin solution of gum tragacanth in water (about one-half ounce to a pint of distilled water), and this was mixed with the porcelain powder, a putty-like mass would be produced that could be readily adapted to the mold.

The corn starch holds the amorphous particles of porcelain together in the biscuit form. If the starch were not used, the mass would be brittle and difficult

to manipulate. The amount of starch added can be varied according to the hardness of the mass desired.

After a thorough mixing, the porcelain-starch powder is placed on a glass slab and the gum tragacanth liquid is added, and the liquid is spatulated into the powder with an agate or stainless steel spatula. The consistency of the mass is controlled by the amount of liquid added to it. The end-product should be a putty-like mass just dry enough to be handled and molded. No surface moisture should be present, but moisture enough for molding without cracking or fracture. The drier it can be used, the more solid the molded tooth will be. Using the mixture too wet will give blisters or blow-holes from the steam produced by the moisture and heat during the setting process in heating the mold.

The mold is then lubricated with a good grade of lard oil applied with a brush. Excess oil should be avoided. This oil will burn out, giving the least amount of trouble as far as specks are concerned, they being more or less a residue from the oil.

After lubricating, both halves of the mold are filled with a slight excess of the putty-like mass of porcelain. The mold is closed and the metal clamps are placed in position. The clamps are then tightened to produce pressure so as to condense the material and also hold the mold together. The surplus porcelain will ooze out of the sides and into the spaces provided for excess in the mold.

In order to set the binder and eliminate the moisture, it is necessary to heat the mold. This is done by placing the clamped mold on an electric hotplate (not on an open gas flame) with a piece of asbestos between it and the heating element. This is heated gradually, but not to the stage where the odor of burning starch can be detected. The odor of burnt starch is an indicator that the molded porcelain is being overheated.

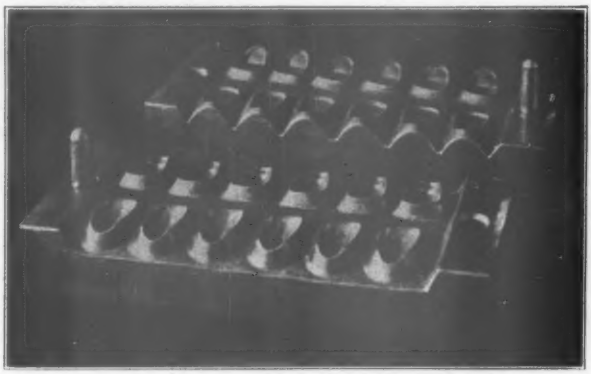

Fig. 4.—Molds for making a number of facings.

After sufficient heating, the mold is removed from the hot plate, the clamps are loosened and the mold is opened. The molded forms can then be readily removed, or, quite frequently, they will drop out of the mold, owing to shrinkage, when it is inverted and tapped. The porcelain facings or slabs are then ready to be fired in an electric furnace for testing purposes.

In molding forms in the spoonlike mold, the porcelain is mixed with distilled water and condensed as previously de-

scribed. Then while the porcelain is still green, it is removed carefully and the molded porcelain is pushed toward the incisal edge of the mold. Needless to say these molded facings will have to be handled more carefully than those containing the binder.

TESTS

The fact that two specimens of porcelain may appear the same on the surface and still vary in physical properties has necessitated certain tests. In any restoration, the testing of the material or a knowledge of its physical properties will always be a factor. The design of the test itself requires the most careful consideration because it is always a compromise between what is possible and what is practical.

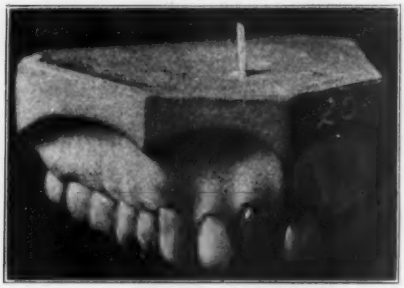

Fig. 5.—Cast and die used in making jacket crowns.

Roentgenographic Examinations.—The detail of the crystal structure of metals and alloys is determined with accuracy by the x-rays, but such information is insufficient for the examination of porcelain specimens. After repeated attempts and exposures varying from one second to fifteen seconds, it was found that this method of testing was of little value in the study of structure or density. As shown in Figures 6 and 7, all that was accomplished was the detection of an occasional gross defect. (Figure 7 (A).)

Microscopic Examination.—It is interesting to note that Gill,[1] by means of photomicrographs, attempts to show certain physical defects and make a comparison of several methods of condensation of dental porcelains in the finished product.

The value of a high-power microscope for the study of fused porcelain is summed up by Felcher[2] as follows:

> How easy it is to be deceived when we are studying fired translucent dental porcelain under a high-power glass. In the first place, it is impossible to cut porcelain as other specimens, making it necessary to study it in bulk. With a high-power lens, the least turn throws some portion out of focus and this will make the air spaces look larger. When other air spaces are brought to focus, something else is blurred. . . .

Clark[3] says:

> We speak of dental porcelains as having pores, air spaces or blebs. These are sealed pores and do not communicate with each other. They can best be studied under a wide-field binocular microscope provided with objectives giving a magnification of 7 and 14 diameters. Their presence determines the vascular nature of porcelain. If they are large and in great quantities, the porcelain is said to have a poor vesicular structure; if they are small and few, the vesicular structure is good.

In arriving at conclusions, both high and low power microscopes were tried, but an ultimate decision was made in favor of the 7 and 14 diameter magnifications.

Brittleness.—Since the Brinell hardness test is dependent on the pressing of a hardened steel ball into the surface of the specimen under a known load and calculating the load and the area of the impression, it was not applicable to porcelain testing. With porcelain, we are particularly interested in impact resistance, but the methods for testing, such as having a hammer strike the specimen and then computing the energy exerted in breaking the specimen, are still in an experimental stage. That a relation exists between the tensile strength and the

impact resistance is known, but a definite correlation still remains to be determined.

Porcelain Specimens for Testing.—After the molding of the porcelain into slabs or facing-like forms, various temperatures, timing and furnaces and a number of bakes were used in firing and fusing the specimens.

A careful record of the procedure used for each specimen was tabulated and the fired specimen was numbered and filed away for further examination. Various materials and methods were tried for numbering the specimens. A mixture of cobalt oxide (black) and oil of cloves mixed to the consistency of a thick black ink and applied to the specimens with a fine pointed drawing or sketching pen, and then fused, was found to serve the purpose best, for it could be applied in very fine lines and small figures. It was then fused in the furnace.

A few of these specimens were pasted on a card and photographed (Fig. 8) for the purpose of demonstration.

Table 1 shows the manner in which the procedures were recorded.

Porcelain Jacket Specimens.—Because of the difference in thickness, the platinum matrix and method of packing, tests were then made with porcelain jacket crowns. Casts were made as shown in Figure 5, with porcelain teeth adjacent to the die upon which the porcelain jacket crown was constructed, as previously described. With casts of this kind, it was possible to note shrinkage, test contact points, etc. The procedure of fusing was carefully recorded as shown on the chart and the crowns were numbered for further study. Only a few of the Justi high-fusing jacket crowns are tabulated to show how the records of all the different kinds of porcelain and different bakes were made.

Fig. 6

Fig. 7

Figs. 6 and 7.—Roentgenographic examination of the facings.

FIRING AND FUSING

Muffle Variables.—Clark found that:

Unfortunately, the color and structural results produced by firing dental porcelain are not entirely within the control of the operator. Different furnaces and different muffles for the same furnace produce slight differences in color and structural results. The most apparent differences are due to size of muffles, the smaller ones having a tendency to gray and lighten the colors because of their insufficient supply of oxygen.

Then too, the temperature of the muffle compared with the pyrometer readings varies some, depending on whether a preheated or a cold muffle is used. Fitzgerald[4] notes experimentally that the temperature as indicated by the pyrometer and the actual temperature within the muffle varied some when compared with the readings of a potentiometer.

Because of the variability in temperature in different locations in the muffle, mention should be made of the possible voltage fluctuations in the supply of current due to a loading or unloading of the current on the line supplying the current. The loading of the line by the use of more current will reduce the voltage and consequently require more time to properly fuse the porcelain.

The condition of the muffle is also a factor. Because of the thinning of the platinum winding wire with repeated use,

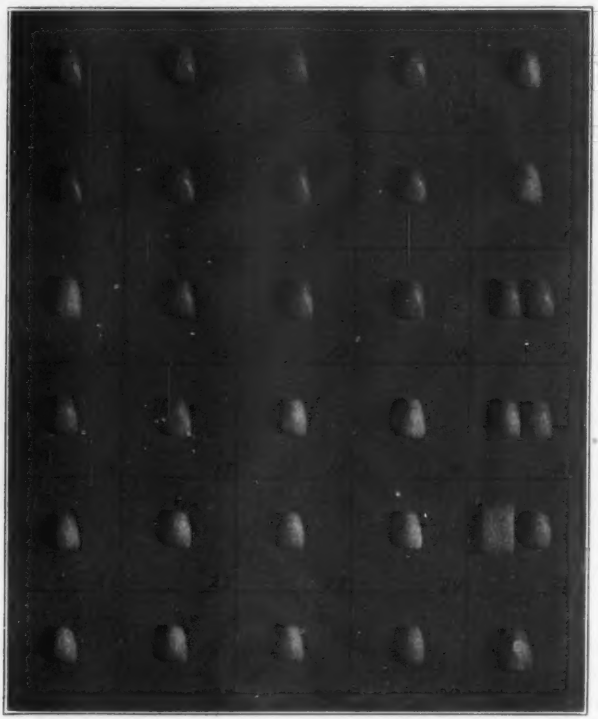

Fig. 8.—Specimens of facings.

porcelain fused near the door or at the front of the muffle will not be sufficiently fused, and consequently all work should be placed as near the thermocouple as possible in order to obtain pyrometer readings of the muffle area in which the porcelain should be fused.

In connection with muffle variables, an old muffle will require more time than a new one for the same results. Corrosion, or oxidation of the thermocouple elements, will also retard heat penetration and prevent the pyrometer needle from giving a true reading.

Effects of Repeated Firing.—The best end-results in fusing porcelain are ob-

tained when the entire procedure can be completed with one baking. Each successive baking has a slightly detrimental effect on the texture and physical properties, and, at the same time, each previous bake fuses at a temperature lower than that of porcelain applied last. Non-fluxed porcelains apparently do not tolerate repeated firing as well as the fluxed, probably owing to the eutectic used in the fluxed porcelain.

Table 1.—Fusing Record

No.	Porcelain	Furn.	1st Bake	2nd Bake	3rd Bake
2	S.S.W.L.F.	A	2′ 1600	2′ 1650	
400	S.S.W.M.F.	D	5′ 1900–2150 Hold 2′ 2200	5′ 1900–2100 Hold 2′ 2200	5′ 1900–2150 Hold 6′ 2250
1039	Justi H.F.	B	6′ 1900–2200 Hold 3′ 2200	7′ 1900–2250 Hold 4′ 2250	
2132	S.S.W.H.F.	C	7′ 1900–2250 Hold 3′ 2250	7′ 1900–2250 Hold 5′ 2250	9′ 1900–2350 Hold 8′ 2350

Table 2.—Porcelain Jacket Crowns, Justi High-Fusing Porcelain

1st Bake	2nd Bake	3rd Bake	4th Bake
	No. 10. Body No. 5 Incisal No. 20		
9 min. 1900–2250 Held 2 min.	8 min. 1900–2300 Held 2 min.	8 min. 1900–2350 Held 2 min.	9 min. 1900–2350 Held 5 min.
	No. 34. Body No. 3 Incisal No. 19		
9 min. 1900–2350 Held 3 min.	7 min. 1900–2350 Held 3 min.	7 min. 1900–2350 Held 4 min.	8 min. 1900–2350 Held 5 min.
	No. 126. Body No. 4 Incisal No. 2		
6 min. 1900–2200 Held 5 min.	7 min. 1900–2250 Held 6 min.	9 min. 1900–2350 Held 8 min.	

Methods.—By surveying the various methods advocated, we gain some idea of the major trend of firing and glazing dental porcelain in a more detailed aspect.

As an example of the time and button method, LeGro[5] recommends the following procedure for fusing S. S. White successive bake or by slightly increasing the temperature of the holding time for each subsequent bake.

Because of shrinkage and requirements of size and form, in all porcelain restorations one or more high-biscuit bakes have to be given before the final fusing or glazing. While the objectionable features of successive firing cannot be entirely overcome, they can be compensated, to a certain degree, by reducing the number of firings to a minimum, by the use of slightly lower fusing porcelain for each 2560° F. and Justi High-Fusing porcelains:

> . . . placing the work, after thorough drying out, in the muffle, starting on the third or fourth button, allowing two minutes for each contact until reaching the contact button that has been previously determined, as the one on which the desired fusing may be accomplished, then leaving the control lever on that contact until the pyrometer registers

the required heat, and then throwing the lever back on contact two when it will be found that the desired fusion has been accomplished.

Felcher[2] is of the opinion that:

The best firing results are to be obtained by the use of lower temperatures over a longer period of time for holding. In that way, there is a complete opportunity for the penetration of the heat units throughout the mass, which makes possible the perfect production of fine carvings, contacts, etc.

Felcher's firing technic for high-fusing porcelain for a three-bake porcelain jacket crown is:

First Bake

Timing the furnace beginning at 1900° F. 1900 to 2200° F. in 5 minutes; 2200 to 2350 in 5 minutes.

Second Bake

For high biscuit fire, carrying out the same procedure except that the temperature by the end of the 10 minutes is carried to 2400° F.

Third Bake

1900 to 2300 in 10 minutes; holding the temperature constant at 2350 for the required few minutes.

Annealing

Allowing porcelain to cool slowly for annealing purposes.

The research of Clark[3] furnishes corroborative evidence in favor of the time and temperature method. He found that:

The factor that seems most important is the synchronization of time by the clock and temperature by the pyrometer, in spite of the fact that certain experienced operators are capable of firing porcelain without the aid of either. Time and button firing is inaccurate if there are any changes in voltage. Pyrometric temperature should be established and maintained in and for definite lengths of time irrespective of the position of the rheostat lever.

In a manual on Dentsply ceramic porcelain,[6] Clark advocates that:

The firing should not be altered to accommodate a roughly carved and finished piece of work. In other words, the time or temperature, or both should not be increased in an effort to produce a smoother crown. Instead, the crown should be fired in the usual way and the roughness polished off on a lathe in the following manner, which requires less than 3 minutes:

Polish the crown with pumice or silica, using a clean rag-wheel kept for this purpose only. Use a great deal of abrasive material and polish to the desired smoothness, but not for so long a time that the entire glaze is removed. A very high luster may be secured with Triplex porcelain polish, but this finish is not always indicated. . . . Porcelain polished in this manner imitates the surface

TABLE 3.—FUSING CHART FOR VARIOUS PORCELAINS*

	S. S. White		Justi			
	Medium	High	Medium	High	Dentsply	T. C.
Type	Fluxed	Fluxed	Fluxed	Fluxed	Non-Fluxed	Non-Fluxed
Ignition loss	0.5 Per Cent	2 Per Cent	1 Per Cent	2 Per Cent	0.5 Per Cent	2.5 Per Cent
Vitrification begins	1750	1950	1470	1950	2150	2200
Low biscuit	1800	2000	1520	2000	2200	2250
High biscuit	2120	2300	2000	2350	2400	2460
Glaze temperature	2160	2400	2070	2400	2400	2460
Glazing time (minutes)	3	5	3	5	5	5

*The data in this chart are accurate only when the pyrometer has been set to fuse S. S. White High-Fusing, Justi High-Fusing or Dentsply at 2400° F. The point is determined on the pyrometer at which an eggshell glaze will be produced by firing samples of any one of these three porcelains at the rate of 50 degrees per minute and holding it at the maximum or glazing temperature for five minutes. The indicator is permitted to idle at this point and then adjusted to 2400° F.

finish and luster of natural teeth more closely than highly glazed porcelain, which has a glassy appearance.

It is interesting to note that Gill,[1] instead of gradually increasing the temperature from the beginning of the chemical stage to its completion, interrupts the increasing temperature periods with holding or soaking periods. He says:

The time factor is equal in importance to the heat factor in the firing of ceramic materials. A method should be followed in which accurate timing under all conditions may prevail.

Timing the firing before the vitrification stage is unimportant, provided the furnace is allowed to heat slowly from 200 F. to the beginning of the chemical stage 1800 F. At the beginning of the chemical stage, the timing must be followed accurately, if the desired result is to be obtained.

other types of restorations, such as inlay and bridge, may necessitate.

Many charts have been formulated, but are of little practical value other than for experimental purposes, because they are based on fusing the porcelain but once. As stated before, most porcelain restorations require at least three bakes; consequently, a technic or chart for fusing and glazing porcelain should involve at least two high-biscuit bakes and a final or glazing bake.

Since heat and temperature are two very important factors in the firing and end-results of the fused porcelain, it is needless to say that they must be synchronized, under control and limited as to the degree of temperature.

The synchronization of time, by means of a timer, with an accurately calibrated

Table 4.—Gill's Technic for Firing and Glazing Three Porcelains

0 to 1400 F. 10 minutes		1400 to 1900 F. 10 minutes
Muffle open		Muffle door closed
Justi High-F	1900 to 2250 F. 5 minutes	Hold 5 minutes
	2250 to 2400 F. 5 minutes	Hold 5 minutes
S. S. White H. F.	1900 to 2200 F. 5 minutes	Hold 5 minutes
	2200 to 2300 F. 5 minutes	Hold 5 minutes
S. S. White M. F.	1900 to 2100 F. 5 minutes	Hold 5 minutes
	2150 to 2200 F. 5 minutes	Hold 5 minutes
Allow to cool in furnace.		

In some of the tests that have been made, by following a scheduled time and decreasing the glazing temperature of the porcelain, the microscope shows a denser porcelain with fewer air spaces. The tendency to deform is less than when the temperature is brought up to a definite glazing point.

Gill's technic for firing and glazing three porcelains is outlined in Table 4.

Formulating Fusing Chart.—In formulating a fusing chart, an attempt was made to incorporate what was found to be the most desirable features to obtain a high quality of fused porcelain. The porcelain jacket crown was used in the final tests, and consequently it will be necessary to make such variations as

pyrometer, a uniform rise in temperature of 50 degrees Fahrenheit per minute and a holding period at a temperature lower than that designated by the manufacturer were finally decided upon. The rise in temperature at the rate of 50 degrees per minute was found ample for uniform penetration of heat throughout the mass and also to allow sufficient time for the pyrochemical changes to take place gradually and efficiently without developing a "crust," which would prevent fusing the inner portion of the porcelain as thoroughly as the outer area. The timer used was an ordinary alarm clock with its dial modified to correspond with the temperature, and a section numbered in minutes

for the holding period after the desired temperature has been reached.

By moving or holding the rheostat switch, the timer and the pyrometer may be synchronized so that the readings are alike and, at the same time, a gradual increase in temperature is effected until the holding period is attained.

The packed and contoured porcelain jacket crown built on a platinum matrix was carefully dried outside the furnace. It was then placed in the furnace and carried through the physical stages, the gases being allowed to escape and oxidation take place before closing the furnace door. The timing was begun at 1900° F., approximately the beginning of the chemical stage for high-fusing porcelains. The time, temperature and holding period were then determined as tabulated on the chart. Each crown was given two biscuit bakes and a final bake or glaze.

Some modifications were necessary for the low-fusing porcelains, the physical stage being completed at a much lower temperature than those of the high-fusing.

This method, as outlined in Table 5, provides for the gradual pyrochemical changes, resulting in a more uniform texture throughout the entire mass. Overfusing and underfusing due to voltage variations are eliminated. The longer holding period reduces the possibilities of failures, which are likely to occur when a short or no holding period is used. The life of the muffle is greatly lengthened owing to the gradual rise in temperature, and the lower temperature at which the porcelain is fired. From an economical standpoint, this is worthy of consideration, for it was found that approximately 50 per cent could be added to the life of a muffle, to say nothing of the inconvenience and loss of time caused by muffle repair. Because of its possibilities of standardization, the fusing may be done by an assistant or by a student with little or no previous experience.

Table 5.—Fusing Chart

Porcelain	First Bake	Second Bake	Third Bake
Justi High-Fusing 2450 F.	6 minutes 1900 – 2200 Hold 5 minutes at 2200	7 minutes 1900 – 2250 Hold 6 minutes at 2250	9 minutes 1900 – 2350 Hold 8 minutes at 2350
S. S. White High-Fusing 2440 F.	6 minutes 1900 – 2200 Hold 5 minutes at 2200	7 minutes 1900 – 2250 Hold 6 minutes at 2250	9 minutes 1900 – 2350 Hold 8 minutes at 2350
S. S. White Med.-Fusing 2300 F.	4 minutes 1900 – 2100 Hold 3 minutes at 2100	5 minutes 1900 – 2150 Hold 3 minutes at 2150	6 minutes 1900 – 2200 Hold 5 minutes at 2200
S. S. White Low-Fusing 1700 F.	2 minutes 1400 – 1500 Hold 1 minute at 1500	3 minutes 1400 – 1550 Hold 1 minute at 1550	4 minutes 1400 – 1600 Hold 2 minutes at 1600
Dentsply High-Fusing	5 minutes 1900 – 2150 Hold 5 minutes at 2150	6 minutes 1900 – 2200 Hold 6 minutes at 2200	8 minutes 1900 – 2300 Hold 7 minutes at 2300
Apco Low-Fusing 1875 F.	5 minutes 1500 – 1750 Hold 1 minute at 1750	5 minutes 1500 – 1750 Hold 1 minute at 1750	6 minutes 1500 – 1800 Hold 2 minutes at 1800

Annealing.—Various terms, such as tempering, maturing and annealing, have been used to designate the process whereby the stresses and strains in the fused porcelain are removed. Proper annealing is accomplished by allowing the

glazed porcelain to cool slowly to room temperature in the muffle before opening the door of the furnace. This procedure produces a strong, translucent porcelain, and avoids crazing and porosity.

The manufacturer of glass products, as well as the industrial ceramists, in order to produce a higher quality of porcelain and reduce breakage, has given this subject much attention. Outstanding in this field is what is known as the Lehr process or device for annealing glassware.

Some porcelains are stronger than others owing to differences in formulae, but all are greatly improved by proper annealing.

CONCLUSIONS

1. Shrinkage is mostly dependent on the amount of flux, water, binder and foreign materials and the degree of condensation.

2. Non-fluxed porcelains will not tolerate repeated firing to the extent that fluxed porcelains will.

3. A preheated furnace heats more rapidly and efficiently than one that has not been previously heated.

4. The time and button method is inefficient and unreliable owing to variation in voltage of the electric current.

5. Increasing the temperature too rapidly prevents uniform pyrochemical changes throughout the mass and results in longer fusing of the outer area than of the inner area.

6. Synchronization of time and temperature by means of a timer and a calibrated pyrometer, in conjunction with a holding period at a temperature lower than that designated by the manufacturer, has better and more uniform results.

7. Greater uniformity of results is obtained, and the possibilities of overfusing are practically eliminated, when a long holding period at a lower temperature is used. If a high temperature with a short or no holding period is used, a slight variation will materially affect the end-results.

8. Porcelain restorations should be completed with the least number of firings. Best results are obtained when the porcelain is completely fused in one firing.

9. In order to obtain translucency and a glazed surface, the firing must be carried beyond the point of complete vitrification. Consequently, its strength and texture are slightly impaired.

10. There is a substantial saving in cost of muffle replacement and repair.

11. The method simplifies and standardizes the fusing of porcelain so that it can be done by an inexperienced student or an assistant.

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EXPERIMENTAL VINCENT'S INFECTION

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THE so-called fusospirochetal flora, found in the lesions of Vincent's infection, is known to be capable of producing disease experimentally. Processes ranging in severity from a localized subcutaneous abscess or cutaneous ulcer to diffuse gangrenous pneumonia or peritonitis have been produced in a variety of species, including man. Exudate or pseudomembrane taken from lesions in man has most commonly been used to transmit the infection; but unpurified cultures, and, more recently, mixtures of pure cultures, have been used successfully. The findings, particularly those obtained with mixtures of pure cultures, have demonstrated the importance of certain members of the flora of Vincent's infection in the production of the lesions. In many of its aspects, Vincent's infection nevertheless remains an obscure problem; and little advantage has been taken of the opportunity for its study afforded by the experimental disease. It is the purpose of this paper to describe the lesions in animals, particularly in the guinea-pig, as a basis for such studies. Clinical and other aspects of this complex subject are not considered in this paper. A review of the literature on the general subject of the etiology of Vincent's infection has been given elsewhere. (Rosebury, 1938.)

REVIEW OF PREVIOUS INVESTIGATIONS

Veszpremi seems to have been the first to report the production of typical experimental Vincent's infection in 1905. Exudate was taken from a fatal case of fusospirochetal periostitis of the mandible with metastatic abscesses in the brain and the lung. Pus from the lung abscesses, containing spirochetes, fusiform bacilli and other bacteria, was injected intraperitoneally into each of two rabbits, and subcutaneously into each of two others. No disease resulted in one of the former pair, whereas the other developed a fatal gangrenous peritonitis with a foul-smelling exudate containing cocci, fusiform bacilli, spirochetes and filamentous bacteria. Both rabbits injected subcutaneously developed foul gangrenous processes with exudate of similar character. A second series of rabbits were inoculated successfully with pus from the first animals. The details given by Veszpremi indicate that the lesions were similar to those described later by other workers, except that the filamentous organism, described by Veszpremi as *Cladothrix putridogenes,* apparently has not been observed since, and may have been an unessential contaminant in the infectious mixture. Veszpremi also reported producing similar lesions with unpurified cultures containing the same mixed flora.

The guinea-pig was first shown by Paul (1910) to be susceptible to fusospirochetal infection. Fatal peritonitis developed in guinea-pigs inoculated intraperitoneally with impure cultures containing the small regular mouth spirochetes *(Spirochaeta dentium,* syn. *Treponema microdentium)* along with fusiform bacilli and cocci. Kritchewsky and Seguin (1920) produced experimental lesions with exudate

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taken from cases of the more common diseases of mouth and throat in which the fusospirochetal flora abounds: Vincent's stomatitis and angina, marginal gingivitis and pyorrhea. Injection subcutaneously of 4 or 5 drops of exudate diluted in 1 cc. of physiologic sodium chloride solution into the groins of guinea-pigs gave rise within a few days to localized abscesses containing greenish yellow foul pus rich in spirochetes of several morphologic types, and, in addition, fusiform bacilli and cocci. Small vibrios were also "often" seen. Kritchewsky and Seguin also distinguished between mild localized lesions, evacuating and producing a healing ulcer, and fatal invasive processes extending from a subcutaneous lesion to involve the pericardial or pleural cavities. It is interesting, in view of our own findings to be presented, that these workers could find no evidence of immunity to reinoculation. A guinea-pig injected as often as six times over a four-month period developed a characteristic lesion each time. It is not indicated whether the successive injections were made in the same or different areas. Finally, these workers were able to produce similar lesions in guinea-pigs by inoculation of mixed cultures. Details of cultivation are not given, and it is not clear whether the mixtures were prepared from pure cultures. It is nevertheless interesting that typical lesions resulted only after inoculation of mixtures containing fusiform bacilli, spirochetes and cocci (either green streptococci or white staphylococci being used successfully). Lesions could not be produced with any of the organisms alone, or with mixtures of fusiform bacilli and either species of coccus. In one instance, a mixture of small regular mouth spirochetes and fusiform bacilli yielded a small putrid abscess. These results are to be compared with the later findings of D. T. Smith and of Proske and Sayers, mentioned below.

Davis and Pilot (1922) have obtained similar results. Putrid infection or extensive necrosis, with an exudate containing spirochetes, fusiform bacilli and cocci, was produced in rabbits by subcutaneous or intrapleural injection of material from pyorrhea, Vincent's angina, lung abscess or gangrenous balanitis. It is noteworthy that these investigators (Pilot and Davis, 1924) also suggested a useful distinction between mild and severe types of human pulmonary fusospirochetal disease, based on a study of thirty-seven cases. The milder cases consisted of a localized putrid bronchitis or lung abscess, with limited necrosis and a greenish fibrinous exudate. The more severe cases, to which the term "diffuse gangrene" was applied, presented multiple cavitation involving a whole lobe or the entire lung, with similar greenish putrid fibrinous exudate.

There have been a number of reported failures to produce experimental fusospirochetal disease. Aside from those instances, to be considered later, in which individual pure cultures were employed, successful animal infection has not always been obtained from the use of mixed cultures or lesion exudate. (Vincent, 1896; Dick, 1913; E. C. Smith, 1933.) These negative findings suggest that, although a mixture of members of the fusospirochetal flora may be pathogenic, its virulence is ordinarily not high, and hence conditions in excess of simple transfer of the infectious mixture may be required for a successful result.

A variety of conditions have been employed experimentally to favor transfer of fusospirochetal infection. Kline (1923) produced gangrenous pulmonary lesions in anesthetized rabbits by intratracheal injection of fusospirochetal material from oral and pulmonary infection in man. D. T. Smith (1927) reported similar successful experiments with guinea-pigs and mice, as well as rabbits, and considered his experiments analogous to the development of pulmonary disease in man by aspiration of fusospirochetal ma-

terial from the mouth during anesthesia. He (1932) also produced a spreading gangrene analogous to noma in guinea-pigs by feeding them a scorbutic diet for three weeks and then inoculating them with fusospirochetal material between the mucous and cutaneous layers of the cheek. Eight of ten normal animals developed only local abscesses after similar injections. Clements (1936) reported the successful production of cutaneous fusospirochetal ulcers in rats (a species otherwise little used for this purpose) by inducing a dietary deficiency of part of the vitamin B complex and inoculating the animals with material from acute gingivitis. Moreover, the area of inoculation had been traumatized. Lesions could not be produced unless both predisposing conditions—dietary deficiency and tissue damage—were present; which suggests that the rat is more resistant than other laboratory animals to fusospirochetal infection.

Among other reports in which conditions predisposing to experimental infection with the Vincent flora are described, mention must be given those of Wallace, Wallace and Robertson (1933), Tunnicliff and Klein (1934) and Tunnicliff and Hammond (1937) on scillaren-B intoxication in dogs, guinea-pigs, rabbits and mice; and of Miller and Rhoads (1935) and Smith, Persons and Harvey (1937) on the ulcerative stomatitis associated with black tongue in dogs. These important papers are apart from the chief theme of this report, and have been reviewed more fully elsewhere. (Rosebury, 1938.)

The predisposing condition most frequently employed has been mechanical traumatization of the tissues. Levaditi (1906) reproduced fusospirochetal balanitis in a chimpanzee with pus from a human case of the same disease by inoculation of the scarified prepuce. Marzinowski (1912) produced angina in a monkey by inoculation on a traumatized tonsil. Strong, Shattuck, Bequaert and Wheeler (1926) were able to produce fusospirochetal lesions in the skin of monkeys and in the testicles of rabbits by injecting material from tropical ulcer in man into mechanically injured tissue.

Kline (1923) regarded mechanical injury to tissue as a necessary condition for successful infection. Using exudate derived from oral and pharyngeal lesions and from pulmonary gangrene, he found that gangrenous infections usually resulted, following subcutaneous injection in guinea-pigs, when the inoculation was made into tissues traumatized with a hemostat; whereas only local abscesses resulted after inoculation of uninjured tissues. Kline, concerned with the pathology of pulmonary gangrene, regarded the local abscesses as "failures"; but he reported that injection of pus aspirated from such local lesions produced typical gangrenous necrosis in the traumatized skin of other guinea-pigs. In view of the findings of other workers, it may be said that the essential difference between the abscesses and the more severe gangrenous processes was one of degree of severity only. Hence, Kline's findings may be interpreted as indicating that tissue injury induced mechanically is an aggravating, but not an indispensable factor in the production of experimental fusospirochetal infection.

This view is substantiated by the work of D. T. Smith (1930). In his earlier experiments, attempts to produce lesions in guinea-pigs with exudate from Vincent's angina had been unsuccessful. Traumatization had not been used, and the exudate had been held for an hour or more before inoculation. Successful guinea-pig infection resulted, on the other hand, when the animal was carried directly to the patient and the injection made immediately. A piece of necrotic membrane was transferred from the patient's throat to a sterile petri dish containing from 5 to 10 cc. of horse serum, cut into small pieces and injected into the groin with a needle large enough to

admit the solid particles. Typical large necrotic, foul abscesses resulted, which were successfully transmitted from guinea-pig to guinea-pig at from ten to fifteen day intervals for fifteen passages. Successful infection was produced, in other words, by means of injection of freshly transferred lesion material in large amount, without the use of trauma or other measures to reduce tissue resistance.

Several other reports are of interest. Lichtenburg, Werner and Lueck (1933) observed that traumatization of the mucosa of the mouth of guinea-pigs resulted in the development of fusospirochetal ulcers even though no infectious material was introduced and neither fusiform bacilli nor spirochetes had been found in the mouth previously. Pratt (1927) found fusiform bacilli and spirochetes in the mouths of untreated guinea-pigs. Presumably, they occur in small numbers there as they do in most human mouths, and seize the opportunity to proliferate in injured tissue. E. C. Smith (1936), working with tropical ulcer in man, succeeded in producing apparently typical, serially transmissible lesions in hedgehogs by inoculation with lesion material under the shaved but untraumatized skin. This worker had failed to produce lesions by similar means in the more common laboratory animals. Weiss (1937) has recently reported that spirochetal material from human mouth lesions could be transferred through mice after preliminary passage through guinea-pigs. Spirochetes appeared in small numbers in the mouse blood twenty-eight days or more after subcutaneous inoculation, and the infected blood was used successfully for subsequent mouse passages.

Particularly noteworthy are reports indicating that fusospirochetal lesions can be produced experimentally in the skin of human subjects. Apostolides (1922), observing the similarity of the bacteriologic picture in tropical ulcer and Vincent's angina, bandaged pieces of pseudomembrane from two cases of angina over the scarified skin, and in two instances succeeded in producing ulcers containing fusiform bacilli and spirochetes. E. C. Smith (1930) produced ulcerative lesions of the skin of human subjects by inoculation with unpurified cultures containing fusiform bacilli and spirochetes. Considered in conjunction with reports of fusospirochetal infections in man following human bite or a blow in the teeth (Peters, 1911; Apostolides, 1922; Fuller and Cottrell, 1929), these observations indicate that fusospirochetal flora is pathogenic for man, just as for experimental animals. Nevertheless, since dentists in particular must frequently contaminate small abrasions of the hands with the flora from infected oral tissues, the rarity of accidental infection again suggests that the flora, although potentially pathogenic, is of comparatively low virulence.

For rigorous demonstration of the pathogenicity of the individual bacterial species found in the fusospirochetal flora, the use of mixed lesion material or of unpurified cultures in the production of experimental disease is obviously inadequate. It is almost unanimously agreed that pure cultures of the individual members of the flora are separately nonpathogenic, or at most produce lesions distinct from those in which the mixed infection is characteristically found. (Tunnicliff, 1906; Noguchi, 1912; Varney, 1927; D. T. Smith, 1932; Proske and Sayers, 1934.) The production of lesions with culture mixtures, in the report by Kritchewski and Seguin previously referred to, suggests that several members of the flora, acting in concert, are required to produce the lesions. The pathogenicity of such a complex mixture has, however, been convincingly demonstrated by D. T. Smith (1930, 1932) and confirmed by Proske and Sayers (1934). From the reports of these workers, it is clear that typical foul, gangrenous lesions developed after inoculation only when the mixture of pure cultures con-

tained all of four micro-organisms: (a) the small mouth spirochetes with regular coils, *Treponema microdentium* or *T. mucosum;* (b) certain varieties of fusiform bacilli, apparently corresponding with *Fusiformis polymorphus* of Hine and Berry (1937); (c) a small actively motile organism regarded as *Vibrio viridans* of Miller (1890), and (d) an inadequately defined anaerobic streptococcus. Successful results were not obtained with mixtures containing other members of the flora in place of one or more of those mentioned, including the larger spirochetes, fine or coarse; other varieties of fusiform bacilli, or *Spirillum sputigenum.* Nor could lesions be produced with mixtures of three or fewer members of the effective quartet.

The pure cultivation of these organisms is technically difficult. While pure cultures are obviously the most desirable means of producing infection in animals for experimental purposes, exudate from human lesions serves as a satisfactory substitute. The lesions initiated by such exudate in guinea-pigs are characteristic and readily transmissible. They maintain a bacterial flora which apparently includes the four organisms described by Smith, and consequently they provide a useful basis for study of the disease and of conditions which influence it. Our studies along these lines are described in the following pages.

EXPERIMENTAL

Material for these studies was supplied from ten cases of mouth infection. Eight of these were in clinic patients, four with acute Vincent's gingivitis, two with chronic marginal gingivitis and two with localized traumatic gingivitis. The other two were in captive chimpanzees with spontaneously occurring mouth disease, one having acute Vincent's stomatitis, the other fatal gangrenous glossitis and stomatitis. Successful initiation of infection in guinea-pigs was accomplished with material from the two animals, from three of the four cases of Vincent's gingivitis, from one case of marginal gingivitis and from one of local gingivitis—altogether in seven of the ten attempts. In two instances, the infection has been carried successfully from guinea-pig to guinea-pig for more than twenty passages without loss of infectivity. The others were discontinued after a few passages.

Method of Implantation and Transfer.—Exudate and débris from the infected gingival crevice was transferred with a sterile scaler to 1 cc. of sterile Ringer's solution, enough material being taken so that the resulting emulsion was definitely turbid and contained particulate matter. The suspension was immediately examined under dark-field illumination, and generally also in smears stained with Sterling's gentian violet. Animal inoculation was carried out within thirty minutes after the exudate was taken from the patient, the suspension having been kept in a cotton-plugged Wassermann tube at room temperature during the interval. For implantation, 0.4 or 0.5 cc., including particles, was injected subcutaneously into the upper inner surface of the plucked thigh of guinea-pigs weighing about 300 gm. In some instances, an incision was made in the skin under ether anesthesia, the muscle traumatized and the inoculum introduced into the wound, the skin then being sutured. This procedure, however, seemed to afford no advantage over simple subcutaneous inoculation; but traumatization of the subcutaneous tissues with the injection needle has been regularly used, and has probably favored the initial implantation of the infective material. After several passages, such traumatization was dispensed with, simple subcutaneous injection being successful. Passage has been accomplished after the lesion had progressed for four days or more, or when fluid pus could be aspirated from it without difficulty. Since the exudate is sometimes thick and caseous, we have found it effective to tap the

lesion with a 22-gage needle on a syringe containing 1 cc. of sterile Ringer's solution as a diluent. In well-developed lesions, amounts of pus ranging from 1 cc. to 20 cc. or more have been obtained. The exudate is transferred to a sterile Wassermann tube and examined under dark field illumination, and about 0.1 or 0.2 cc. is injected subcutaneously into fresh guinea-pigs. Two or more guinea-pigs have been used for each passage.

Course and Character of the Lesions.—Twenty-four hours after inoculation, an area of diffuse swelling and erythema appears at the site of injection. Within another day, the erythema subsides, but the swelling increases during three or four days, or more, inducing more or less marked flexion of the leg. The further development of the lesion generally follows one of two courses, one of which eventuates in recovery, the other in death.

In the former instance, the borders of the swelling become more distinctly palpable after about the fourth day, until, at the end of a week or more, a bulbous, well-localized abscess is present. (Fig. 1.) Usually, when this stage is reached, the swelling is not less than 2 cm. in diameter. It may increase indolently, over an additional period of about two weeks, to 4 cm. or more. When tapped, the abscess yields an abundance of exudate of varying consistency, ranging in color from pale yellow to dirty greenish gray, and having a characteristic strong putrid odor. In the first few passages, gas may be present, but later it disappears. Exudate taken from abscesses in this stage has most frequently been used for passage. Eventually, the abscess points and evacuates, forming a deep ulcer with smooth rounded edges, which continues to drain pus of similar character during another two weeks or so, as the swelling subsides. Finally, the lesion heals with little scarring, usually leaving only a barely palpable area of induration. The total course from injection to recovery takes from three weeks to two months.

In the more severe type of infection, localization does not occur. Sometimes as early as forty-eight hours after inoculation, but generally not until several days later, a tract can be palpated extending from the upper margin of the local swelling either along the side or over the abdomen. Generally, the appearance of this palpable extension presages the ultimate course, which is one

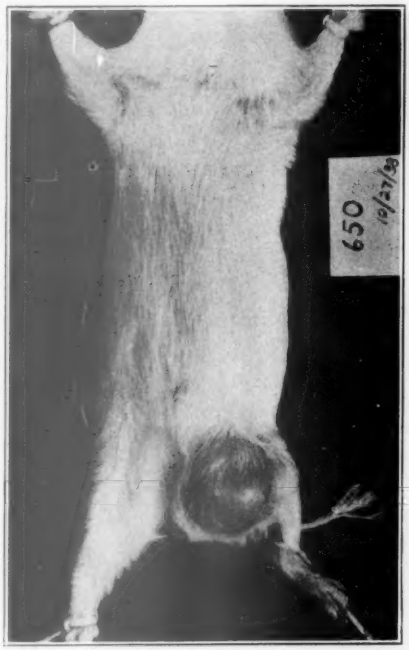

Fig. 1.—Fusospirochetal abscess in guinea-pig; typical localized response to subcutaneous inoculation in groin, tending to evacuate and heal.

of diffuse gangrenous cellulitis. Occasionally, a tardy localization occurs. The extension tract itself becomes walled off, forming one or more abscesses in addition to that in the groin, each of which follows a course similar to that described above. Otherwise, death occurs a few

days after the extension tract is first palpated.

At necropsy (Fig. 2), the initial lesion in the groin is one of putrid gangrene of the subcutaneous and adjacent muscular tissues, which are discolored dark greenish gray to black. This area may or may not be partly surrounded by a fibrous capsule. From it, a channel lined with dirty greenish fibrinous exudate, lighter in hue than the groin lesion, and filled with fluid of the same color, extends

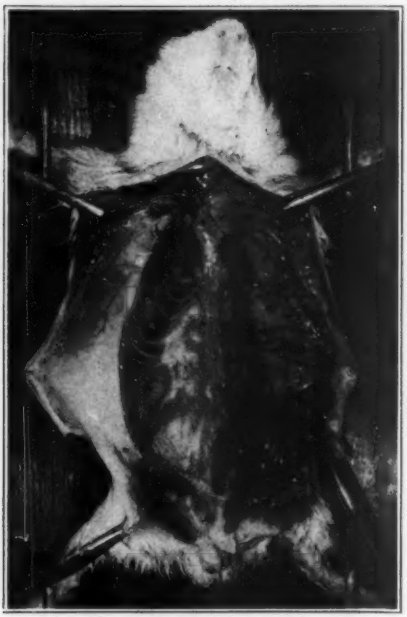

Fig. 2.—Fatal diffuse fusospirochetal gangrene in guinea-pig. The site of infection in the left groin is deeply discolored. A tract lined with foul greenish gray fibrinous exudate extends to the left axilla and across the midline of the thorax. The lower right side is unaffected.

sometimes along the side to the axilla, sometimes across the whole abdominal and thoracic wall. The inguinal and axillary lymph nodes are generally intensely congested and hemorrhagic. Samples of the fluid or of the fibrinous lining taken from any part of the lesion are alike in bacteriologic picture, containing the same flora as the pus from the local abscesses, as described below. In our experience, this process has never penetrated into the peritoneal or pleural cavities, but is limited to the subcutaneous connective and muscular tissues. Liver, spleen, kidneys, adrenals and other abdominal organs generally appear normal. The lungs are often hemorrhagic and the right side of the heart is dilated, probably as a result of agonal changes.

The two types of response just described resemble to a degree the extremes of Vincent's infection in man: gingivitis as contrasted with noma, or lung abscess and pulmonary gangrene as described by Pilot and Davis (1924). In animals of equal weight, equal doses of the same exudate produce local abscesses in some and diffuse gangrene in others. Larger doses produce a greater proportion of diffuse gangrene.

The Bacteriologic Picture.—Certain changes in the flora during the course of animal passage, as observed particularly under dark-field illumination, are worth consideration. The original mouth material is of course a very complicated bacteriologic mixture. (Fig. 3.) Many of its component species disappear after several animal passages. These include the aerobic members. Occasional aerobic cultures on blood-agar prepared from animal exudate after several passages have been uniformly sterile. Gas formers, whether aerobic or anaerobic, likewise soon die out, as do the coarse filaments associated with tartar.

The exudate from human lesions contains, as a rule, four morphologic varieties of spirochetes: large delicate forms with open spirals, regarded as *Treponema vincenti;* large coarse, double-contoured forms with open spirals, corresponding to *T. buccale* as described; large thin forms with regular spirals, more tightly wound than the preceding, and frequently seen as double or complex spirals,

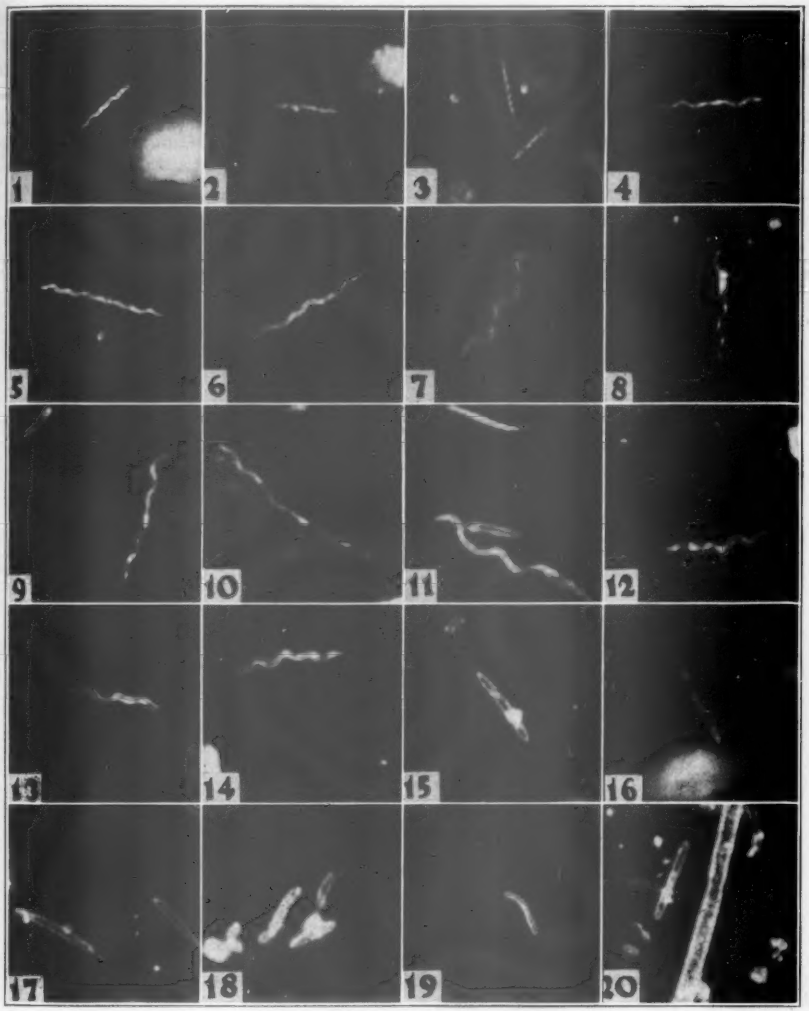

Fig. 3.—Dark field photomicrographs of fusospirochetal flora in exudate from gingivitis in man. (× 1800.) 1, 2, Treponema microdentium. 3, T. microdentium and cocci. 4, 5, 6, T. macrodentium. 7, 8, double or complex spirals, probably T. macrodentium; 9, T. macrodentium or T. vincenti with bacillus. 10, T. vincenti. 11, T. vincenti with bacillus and T. microdentium. 12, 13, 14, T. buccale. 15, vibrio and chain of bacilli. 16, small double fusiform bacillus. 17, large fusiform bacilli. 18, 19, spirilla. 20, leptotrichia filament with fusiform bacilli and cocci.

regarded as *T. macrodentium*, and smaller forms with regular tightly wound spirals, resembling the spirochete of syphilis, regarded as *T. microdentium* (or *T. mucosum*). There was a lack of coarse double-contoured spirals in one of our longer series from the start, apparently not affecting the result. Delicate open

spirals have not been prominent under dark-field examination in our preparations, whether taken from human or from animal exudate. It is worth noting that, in stained smears, it is difficult to distinguish these open spirals from the other thin spirochetes, because of distortion. (Figs. 4, 5.) The more tightly wound spirals, both small and large, however, have tended to persist through animal passage, the smaller forms being generally more numerous than the large. granular and homogeneous. The large granular forms are particularly prominent in stained smears. (Fig. 4.) After several passages through guinea-pigs, however, these large forms have disappeared. The smaller forms, moreover, although they have persisted, seem to have undergone relative reduction in numbers; so that, in a typical preparation from animal exudate (Fig. 5), they may be far outnumbered by other organisms. In the report of Veszpremi (1907), a somewhat

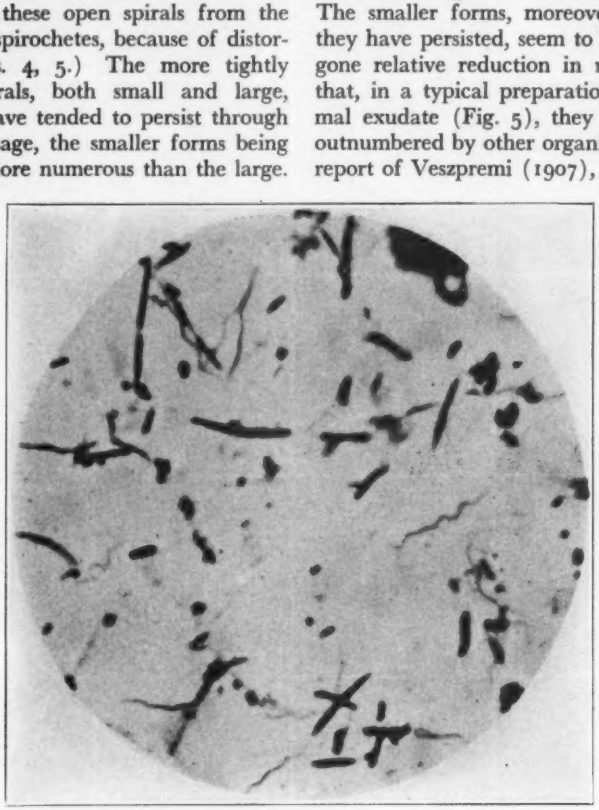

Fig. 4.—Preparation from Vincent's gingivitis in man. (Sterling's gentian violet; × 1500 approx.) The spirochetes all resemble T. vincenti, but other types are present, distorted by drying. Large fusiform bacilli are prominent.

Together, they usually predominate numerically over all other organisms in the flora. These findings are in harmony with those of D. T. Smith and Proske and Sayers, who reported that the small regular spirals alone participate in the pathogenic mixture.

The original exudate generally contains several morphologic varieties of nonmotile fusiform rods, large and small, similar observation was recorded; and, in general, this finding accords with previous observations that only certain types of fusiform bacilli take part in the pathogenic mixture of pure cultures.

Constantly present in the exudate from human lesions, and persistent during the course of animal passage, are small vibrios and cocci. The vibrios, from two to ten of which usually occur in a micro-

scopic field containing several hundred spirochetes, are prominent because of their rapid darting movements. The cocci, occurring singly, in pairs and less commonly in short chains, are usually not numerous in comparison with the spirochetes. Finally, spirilla, curved or bent rods with rounded or tapering ends, larger than the vibrios and more sluggish, occur irregularly, but may persist through animal passage; and non-motile rods, straight or curved, with rounded rather than tapering ends, are present inconstantly and may persist in small numbers. These rods may be fusiform bacilli or immobilized spirilla, or other organisms.

The exudate also contains leukocytes in varying number, including both polymorphonuclear and mononuclear cells, and frequently a considerable collection of amorphous strands which are presumably fibrin.

Reinfection of Recovered Animals.—The findings on seventeen animals that were reinoculated in the opposite groin after recovery from a groin abscess indicate rather clearly that recovery confers no demonstrable general immunity.

Three of these animals showed smaller lesions the second time; five showed lesions about equal in size and character on the two occasions, and nine showed larger lesions following the second injection. In five of the last nine, the second lesion terminated as a fatal diffuse gangrene. On the other hand, ten animals reinoculated after recovery in the *same* area showed a somewhat different picture. Six of these had smaller lesions the second time. Of these, three had only small nodules, which followed the exceptional course of healing by resorption without evacuation. In two others, the second response was about equal

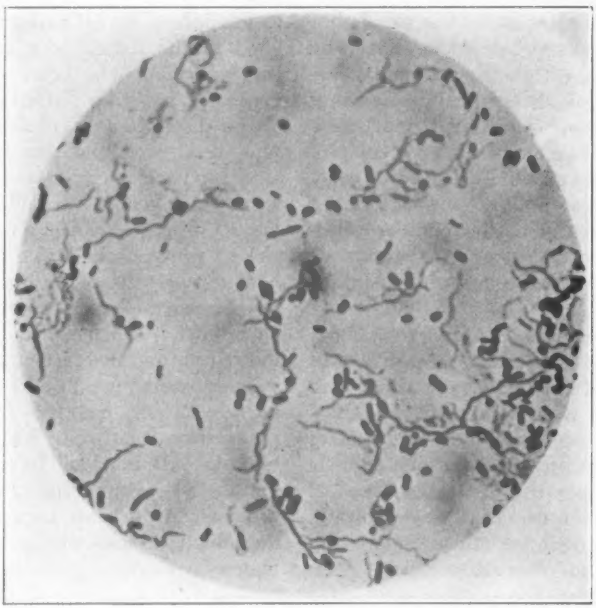

Fig. 5.—Preparation from exudate of fusospirochetal infection in guinea-pig. (Sterling's gentian violet; × 1500 approx.) The spirochetes are distorted by drying. Under dark-field examination, only microdentium-like and macrodentium-like forms are seen. (Compare Figure 3 and see text.) Only small fusiform bacilli are present.

to the first. Of the remaining two, one died after the second injection with diffuse gangrene, whereas the other developed a very much larger local lesion in the second instance; but the circumstances were peculiar in both of these cases. In the former animal, the first lesion had been a small abortive swelling induced by injection of exudate from a human case. This was one of the three instances in which we failed to transfer the infection to other guinea-pigs. In the other animal, only a small abscess developed at the site of inoculation after reinjection in the groin, but several secondary abscesses developed by extension from it on the abdominal surface. One of these, the largest local abscess that we have seen, reached a maximum diameter of about 8 cm. All these abscesses eventually healed by evacuation. These findings suggest that a relative degree of local immunity develops after recovery, tending to restrict the development of a second abscess in the same area.

Effects of Inoculation by Other Routes.—We have made several tests of the effects of inoculation elsewhere than in the groin with exudate from guinea-pig groin abscesses. Since only one or two animals were tested by each of these routes, the negative results obtained in some instances may not be significant. Intravenous injection of pus, in two animals, had no observable effect. After forty-eight hours the blood of one animal showed no organisms under dark-field illumination. In the other, occasional small regular spirochetes and a few fusiform bacilli were found. Anaerobic cultures of guinea-pig blood-hormone-agar made at this time from both animals remained sterile. One of these guinea-pigs developed a local abscess on the foot at the site of intravenous injection as a result of contamination of the subcutaneous tissue. The typical fusospirochetal flora were recovered from the exudate. Intraperitoneal inoculation produced a foul fibrinous peritonitis in two animals, fatal to one in six days and to the other in nine days. The exudate, covering all the abdominal organs, was similar in appearance to that found in diffuse gangrene of the subcutaneous tissues and showed the same bacteriologic picture. It is interesting that each of these animals had recovered from three consecutive groin abscesses, and that one had been inoculated with exudate intravenously without result, before succumbing to intraperitoneal inoculation—further evidence of the absence of general immunity to this infection. Of two animals inoculated in the testicle, one remained entirely normal. The other gave no evidence of testicular infection, but died eleven days after inoculation with fusospirochetal peritonitis similar to that observed in the animals just mentioned. One animal injected intra-orally in the sublingual tissues developed a large localized abscess which drained thin foul greenish fluid through the mouth, containing the fusospirochetal flora in less than the usual abundance. When killed, this animal showed no oral involvement, the mucous membrane sublingually and elsewhere appearing entirely healthy. Exudate from the lesion itself was bacteriologically typical. No fistula could be seen; but since the abscess involved the salivary glands, drainage may have occurred through their ducts. Finally, one animal was inoculated intra-orally by instillation into the mouth, without injury to the tissues, of the relatively enormous dose of 2 cc. of undiluted pus. This guinea-pig gave no indication of disease either local or general, and spirochetes could not be recovered from the mouth one week later.

Preliminary Findings in Further Experimentation.—The great value of experimental fusospirochetal infection, as we see it, lies in the opportunity that it affords for the study of predisposing or modifying factors in the disease. The infectious mixture, maintained by continuous passage through guinea-pigs, is

available at all times and in quantity ample to permit inoculation of uniform groups of animals. Since the pathologic changes produced are consistent and to a large degree predictable, a means of investigation is available which should yield far more satisfactory results than could be expected from clinical research in the same field. A brief account is appended of one such experimental study, to be reported in detail elsewhere.

THE EFFECT OF NEO-ARSPHENAMINE ON EXPERIMENTAL FUSOSPIROCHETAL INFECTION*

Although the arsphenamines have been widely used for the treatment of Vincent's infection in man, both oral and extra-oral, clinical opinion is divided as to their efficacy. Reports favoring their use (D. T. Smith, 1933) are not entirely convincing; and cases such as those of Sutton (1924) and Williams (1929), in which Vincent's angina developed in patients undergoing antisyphilitic treatment with arsphenamines, would seem to furnish strong evidence against their use in these diseases, at all events when administered systemically. Experimental fusospirochetal infection provides an opportunity for controlled study of this question. Only two previous attempts to study it in this way seem to have been made. Lichtenburg, Werner and Lueck (1933), in the paper referred to previously, reported treating the local lesions, produced in the mouths of guinea-pigs by traumatization without exogenous infection, with sulpharsphenamine given intraperitoneally. Four large doses of the drug (0.025 gm. per kilogram of body weight) were given on alternate days. The results as compared with those in untreated controls showed no advantage for the treated animals. D. T. Smith (1933), on the other hand, reported that a single dose of 0.01 gm. of sulfarsphenamine per kilogram (route of administration not stated) reduced the infection in guinea-pigs "materially," and that the exudate in treated animals was incapable of producing abscesses in fresh guinea-pigs.

Our experiments were conducted with neo-arsphenamine in dosages ranging from 0.006 to 0.018 gm. per kilogram of body weight. Preliminary experiments had indicated that larger doses were toxic. In the first experiment, twelve guinea-pigs were inoculated uniformly with exudate from a guinea-pig groin abscess. Six of these received, mixed in the syringe with the exudate immediately before the injection, a single dose of 0.006 gm. per kilogram of neo-arsphenamine. The results showed a striking difference between the two groups. In the controls, deaths with diffuse gangrene were more numerous and more rapid, and the exudate from the treated animals showed a distinct reduction in numbers of bacteria, particularly of the spirochetes. Lesions nevertheless developed in all the treated animals. In the next series, eighteen animals were injected uniformly with portions of the same exudate. On the following day, when all the animals showed characteristic local reactions, neo-arsphenamine was given to four animals intravenously and to eight others directly into the lesion, the groups being selected so that the control and two experimental groups included a similar range of severity of lesions. Survivers in the treated groups were given five consecutive daily injections by the same routes, the dosage for both beginning at 0.006 gm. and increasing by daily increments of 0.003 gm. to 0.018 gm. per kilogram of body weight. Grossly, the findings in this experiment seemed conclusively negative. There was no significant difference either in size of lesions or in number or rapidity of deaths from diffuse gangrene, in the three groups. There was, however, a striking difference in the character of

*Part of the expense of this study was defrayed through the courtesy of Houghton Holliday, dean of the School of Dental and Oral Surgery, Columbia University.

the exudate in the animals treated by injection into the lesion. It was scanty, thin and odorless, and microscopically showed very few bacteria, with only occasional spirochetes, as contrasted with the characteristic picture in the controls. The animals treated intravenously did not show this difference, the exudate being identical with that in the controls. Transfer of exudate from the local abscess in the one survivor of the intravenous group to the groins of two fresh guinea-pigs produced rapidly fatal diffuse gangrene in one and a typical local abscess in the other, with exudate showing the complete flora in both.

As a check on the evidence of drug action in the animals given neo-arsphenamine by injection into the lesion, seven additional guinea-pigs were infected as before. On the following day, four of these, selected as before, were given 0.012 gm. per kilogram of neo-arsphenamine, by injection into the lesion; and the next day these and an additional member of the group were given 0.015 gm. per kilogram in the same way. Twenty-four hours later, all five were given an additional injection of 0.018 gm. per kilogram into the lesion. Probably because of the larger initial dosage of the drug employed, the results in this experiment were much more striking than before. Although all seven animals developed lesions, those of the treated animals were much less marked than those of the untreated controls. In the exudates, moreover, which differed in gross appearance as before, the controls showed several hundred spirochetes per microscopic field; whereas the treated animals showed from two per field to as few as one per ten fields. The other organisms in the flora likewise were markedly reduced in numbers in the treated animals, although examples of each type could be found on diligent search. Finally, although exudate from the controls reproduced typical lesions in fresh animals, that from each of the treated animals failed to produce a lesion in a fresh animal.

These results indicate that although intravenous administration of neo-arsphenamine, under the conditions of these experiments, was ineffective in altering the course or character of experimental Vincent's infection, when the same drug was applied in direct contact with the flora, there was a distinct ameliorative effect.

SUMMARY

Previous observers have reported the experimental production of transmissible putrid gangrenous lesions, with material containing the flora of Vincent's infection, in a variety of animal species and man. Their findings, particularly those in which mixtures of pure cultures were used successfully, demonstrate the pathogenicity of a complex of micro-organisms including spirochetes, fusiform bacilli and other organisms. In this report, these findings are reviewed, and data are presented on original studies with guinea-pigs which confirm and extend some of them. Lesions produced in the groins of guinea-pigs by subcutaneous inoculation with human mouth material have been transmitted for more than twenty passages. Two types of disease result from such inoculation, apparently differing chiefly in severity, and evidently corresponding with extremes of fusospirochetal infection in man. These are local putrid abscesses, tending to heal by evacuation and the formation of ulcers; and fatal diffuse gangrene of the subcutaneous tissues. The milder lesion is capable, on passage, of reproducing the more severe. In both, the exudate shows a characteristic microscopic picture of fusospirochetal infection, containing small regularly wound spirochetes as the predominant form, accompanied by small fusiform bacilli, vibrios, cocci and other bacteria. The large open-mouth spirals and the large granular fusiform bacilli commonly seen in human lesions tend

to disappear from the animal exudate, along with aerobic contaminants, gas-formers and filaments. Data are given which indicate that no general immunity is conferred by recovery from these lesions, although a slight local immunity to reinfection seems to develop.

The results of inoculation of the exudate by various routes other than subcutaneously into the groin are described. Preliminary data are given on the effects of neo-arsphenamine on these lesions.

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PRESERVATION OF THE TEETH BY CONTROL OF ORAL BACTERIA

By JOHN J. MOFFITT, D.D.S., Harrisburg, Pa.

SINCE the teeth play such an important part in the nutritive activities of the body, they were probably originally intended to last a lifetime. If they do not do so, it is quite as likely that they are not receiving the intelligent treatment that they should. Streptococci, staphylococci, pneumococci and many other pathogenic organisms are continually being introduced into the oral cavity in milk, water and foods, and by direct contact. Because the ultimate destruction of the teeth is due to these organisms, a rigid bacteriologic technic must be observed in all contacts.

With expensive sterilizers, spraying apparatus, paper cups and other evidences of the aseptic environment, we strive to impress our patients with our care for their welfare. Then, after an operation, during which we have adjusted a headrest, reached for an instrument in a container, changed a bur in a handpiece and touched a drawer handle, we must wash our hands to rinse off the residue from the operation. At all these contact points, but especially the spigot of the washstand, are the germs which the expensive sterilizer cannot reach—cocci and bacilli—all ready for the next patient.

With such a conception of the actuality of the presence and menace of pathogenic micro-organisms, it is scarcely a cause for wonder that the bacteria of the oral cavity often get beyond control.

There are three important factors in preventing loss of the teeth by control of bacterial invasion: cleaning, filling cavities and treating infected pulps.

It may seem preposterous to assert that the teeth should be cleaned every month, yet once the reasons are made clear to intelligent patients, the majority insist on having it done. And when it is done with due observance of laboratory technic, it is an operation of high rank, requiring both knowledge and skill; for indubitably this operation inefficiently executed can shorten the patient's life. Too many people classify cleaning the teeth with hair curling, manicuring and other beauty-parlor activities—the appearance being the chief object. We must instil a proper conception of the value of cleaning the teeth for control of bacterial invasion of the oral cavity, that the teeth may not only retain their beauty, but also, and what is more important, continue their physiologic functions of maintaining and prolonging life.

We are told, by what authority I do not know, that the teeth should be cleaned and examined by a dentist every six months. Laboratory findings show that there are very few people who can allow one month to pass without having the teeth cleaned by a competent dentist and not risk serious detriment to and early loss of the teeth. Here is the report of a case sent in for laboratory investigation, the material examined being taken from subgingival cervical areas.

Slide preparation: Streptococci, diphtheroid bacilli (pseudodiphtheria bacilli), Vincent's spirilla and fusiform bacilli.

One week after a thorough cleaning of these teeth, a slide was made, and a

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report from the same laboratory showed the following results:

Slide preparation: A large amount of pus (numerous polymorphonuclear leukocytes), large squamous epithelial cells, great numbers of Vincent's spirilla and fusiform bacilli, diphtheroid bacilli (pseudodiphtheria bacilli) and a few streptococci.

The report shows how rapidly organisms multiply in the mouth.

Few people past the age of 40 have thirty-two teeth, for reasons that do not reflect credit on our intelligence. Yet every tooth, including the third molars, is designed to play a part in prolonging life and usefulness.

In the care of the teeth, attention must first be applied to prevention of the encroachment of invading organisms. Cultures from the mouths of healthy normal children, taken from the subgingival tissues, fissures in the deciduous teeth, tonsils and nasopharyngeal region, demonstrate the presence of pathogenic organisms. Here is a typical laboratory report:

Cultures from Paul J., aged 3:

1. Tooth cavity: *Streptococcus viridans,* many gram-negative diplococci and a few diphtheroid bacilli (pseudodiphtheria bacilli).

2. Tonsils: *Streptococcus viridans, Micrococcus catarrhalis* and some long slender filamentous gram-positive forms, probably some variety of Leptothrix.

3. Subgingival, upper: *Streptococcus viridans* and *Micrococcus catarrhalis.*

4. Subgingival, lower: *Streptococcus viridans, Micrococcus catarrhalis* and a few diphtheroid bacilli (pseudodiphtheria bacilli).

5. Nasopharynx: *Streptococcus viridans* and *Micrococcus catarrhalis.*

The patient was of a normal family, the father a banker. There was no visible evidence of anything abnormal or pathologic except a small cavity in a deciduous molar.

If these organisms are permitted to multiply, they will form a sticky albuminous substance along the gingival margin, where the germs find shelter, and which will soon become impervious to the casual activity of the toothbrush. If they are not controlled or eradicated, they soon infect the dentin and are transmitted to the permanent teeth. Later, they can be found in the sutures of the permanent molars and bicuspids and along the gum margins of the anterior teeth. If they are not removed as rapidly as they grow, the subsequent years will demonstrate their ravages. At first, their presence can be determined only by laboratory tests. If the dentist trusts his eyesight to determine when teeth should be cleaned, the usual cavities, abscesses, recession of the gums, pyorrhea, erosion, etc., will inevitably follow.

Microscopic examination of the teeth of average normal persons, together with incubated cultures, as previously stated, shows that few patients should let more than a month go by without having the teeth examined and cleaned by a dentist, if they hope to keep the teeth through life. This monthly attention must be given by one conversant with bacteriology as well as with oral hygiene. The gum cushions that expel extraneous matter from between the teeth must be freed monthly from bacterial invasion that destroys the attachment of the gingival tissues to the peridental membrane, infecting the fibrils connecting them, and so reducing their elasticity and functions. *Streptococcus viridans* and *Streptococcus hemolyticus* seem to start these lesions. If the teeth are not cleaned monthly, protected areas are formed, with serum as a medium where countless colonies of organisms, as yet invisible, begin their activities. In later years, no treatment will restore the lost tissues, but the progress of the infections can be materially retarded.

Following are a few cases that did not receive treatment at an early stage:

Case 1.—A manufacturer developed systemic pyorrhea. He found the disease gain-

ing ground, and, being of punctilious habits, he made an appointment for 9 o'clock the first Monday of each month to have his teeth scaled and treated. He adhered faithfully to this schedule and retained all of his teeth until his death many years later.

CASE 2.—A man who had swollen, congested gums and incipient pyorrhea has had his teeth scaled and treated every three weeks for more than ten years, because his father lost his teeth from pyorrhea and died of septic poisoning ascribed to his dental condition. The patient not only has every tooth, but also is free from severe gingival lesions and has a decidedly healthy mouth. The treatment has been augmented by the use of autogenous vaccines.

CASE 3.—A woman whose social obligations have made it necessary for her to have the best looking teeth possible has had her teeth cleaned and scaled every four weeks for twenty-five years. During this period, she has had almost every kind of infection possible to be found in the mouth: erosion, cervical cavities, infection of the pulp and Vincent's infection. Except when absent from home, she has kept up this program of care continuously, and, at the age of 64, she has thirty-one teeth, of very good appearance and with no visible signs of artificial restorations.

CASE 4.—A woman whose mother had lost all her teeth from calcareous deposits, pyorrhea and lack of care, developed severe pyorrhea and looseness of the teeth and was anxious to preserve the remaining teeth, fifteen in number, most of them quite loose and diseased. She had her teeth scaled and cleaned every two weeks when they were at their worst, and later every four weeks, for more than twenty years. She now has twelve teeth, some of them with sufficient stability to support bridges.

These teeth would have been lost more than fifteen years before if this schedule had not been rigidly followed.

After removal, calcareous deposits sometimes recur in less than two weeks, invisible in the colonies of organisms. Within a month, the dentist can remove them with fine round points that will not scratch the teeth or injure the gums. If several months elapse, it is necessary to employ the conventional scaler, designed to assist the dentist in detaching actual crusts of deleterious matter from the teeth. No other fine mechanism is treated with such indifference.

Consider a child of 10 years whose teeth have gone uninspected for several months: Colonies of organisms form along the gingival margin and become infiltrated with minute inorganic crystals. None of this process is visible, but it has been demonstrated many times by cultures and slide preparations. The inorganic crystals irritate the fibrils that hold the gums to the teeth, and, under the calcareous ridge, a little serum exudes, as yet invisible to the eye, but an incubating ground of countless organisms. What follows depends on the kind of organisms that find these perfect incubators, which abound in every uncared-for mouth, and on the susceptibility or immunity of the patient to them. In a few years, these lesions are extended; more of the vital fibrils become detached; leukocytes that have been drawn to the area by the irritation are destroyed by the pathogenic organisms, and pus forms, imperceptible except through the microscope. The destroyed white corpuscles liberate ferments, and these, together with the products of germ growth, soften the tooth structure, and erosion, recession of the gums, caries or pyorrhea gains a foothold. This goes on so gradually that it is unnoticed by patient and dentist alike, until, years later, the pain of exposed dentin or the unsightliness of the teeth demands attention, and then it is too late. In middle life and toward old age, the infection penetrates more deeply into the dentin, until it reaches the pulp. Then follows, similarly to the formation of gall-stones or kidney stones, a calcification of the pulp, caused by the presence of invading organisms (a frequent cause of facial neuralgia), and later death of the pulp. These organisms have been traced from infected cervical areas, through apparently solid dentin, to the pulp chamber, and have

been found in the live pulp, where they flourish for months before the pulp dies.

Following is a report on a live pulp sent in for examination.

Histologic examination of tissue from Miss B, marked "live pulp from tooth" resulted as follows:

Gross appearance: A small string of tissue 4.0 cm. long, 0.1 cm. in diameter at one extremity, tapering down to a point 0.03 cm. at the opposite extremity. The larger extremity is soft and dark red and appears to be pulp and the smaller slender extremity is white and appears to be nerve.

Histologic description: The embryonal reticular tissue of the dental pulp has lost its normal character and is densely fibrosed, appearing as a solid mass of collagen fibers which, in places, shows hyaline degeneration. The entire central portion of the mass is an extensive area of calcareous infiltration.

The layer of odontoblasts may be seen at the periphery of the fibrous tissue, but the cells are small and shrunken instead of appearing as large cylindrical cells.

A special stain for micro-organisms shows numerous streptococci throughout the fibrosed and calcified pulp.

Diagnosis: Fibrosed and calcified dental pulp infected with streptococci.

From the observation of many of these cases of infected live pulps, it is evident that the various systemic diseases ascribed to transmitted or secondary infection from the teeth do not come from the so-called "dead teeth," but from the infection of live pulps prior to their death. The lymph spaces and thinly coated veins of the pulp furnish a direct entrance to the circulation, which is not available after their destruction. It must be borne in mind that no infection can be transmitted from any source unless the patient is susceptible to the organism. If a root canal has been inexpertly filled, some of the organisms with which the system had been infected, from whatever source, may find there a weak spot in which to proliferate and form an alveolar abscess. This has led to the belief that the so-called "dead tooth" is the cause of the systemic disturbance, but evidently it was the infected pulp which, while still alive, was the origin of the trouble.

A normal young man had the pulp of a central incisor devitalized by a fall. There was no infection. The pulp was removed to prevent discoloration. After the canal was bleached and sterilized, a gutta-percha filling was tightly inserted. From the air pressure thus induced, a rarefied area appeared at the apex. It was somewhat sore, but not infected. Apparently, it was an alveolar abscess, yet could not affect the patient systemically. When drainage was effected and the pressure released, the tissues returned to their normal condition about the apex.

Another young man, normal and vigorous, had a lower right first permanent molar with a live pulp exposed infected from an approximal cavity. There was no pressure on the pulp and not much pain. The patient delayed having the tooth treated. He was healthy and had no unfavorable family history, but within a year he died of heart disease.

The handling of cavities in the teeth is of equal importance, if the teeth are to be preserved during the patient's life. Invasion by pathogenic organisms usually begins in the deciduous teeth of normal patients, from permitting the teeth to go for more than a month without cleaning and inspection. The organisms subsequently appearing in the permanent teeth are identical with those found in the deciduous teeth of the same patient.

A cavity in a tooth is the result of a series of events that could have been prevented. *Now,* it becomes necessary to prevent infection from reaching the pulp.

Many organisms to be found in this cavity can be grown in various media, but the ones we are concerned with are those that propagate in blood or serum, for they are the ones that can penetrate the tubuli of the teeth, induce caries and finally gain entrance into the circulation. The others flourish on already disintegrated dentin and decomposed food substances and need not be considered here. Human blood-agar is used

as the medium for the growth of those organisms that cause the initial invasion of the teeth.

The operator shapes the cavity according to his idea of retention and prevention of further decay. When all discoloration has been removed and the dentin seems hard and natural in color, and the design of the cavity is satisfactory, it is usually wiped out with carbolic acid and alcohol or other germicides and solvents, and the filling is inserted. The filling is anchored securely and will remain in place an average of ten years.

Some dentists say with pride that their fillings have lasted forty or fifty years, but, from a bacteriologic standpoint, that is nothing to boast about. Fillings allowed to remain until they come out of their own accord, that is, because of failure of the structure of the tooth to furnish further anchorage, are a menace to health. One of the most frequent causes of infection of the pulp and alveolar abscesses is the filling that is permitted to stay in place too long. Examination of the dentin beneath many fillings of long duration reveals areas of infected dentin gradually impinging on the pulp. To prevent this encroachment on the pulp, the cavity, when first excavated, should have a sterilizing agent sealed in it and left for several days before the filling is inserted. After two years, any filling displaying signs of leakage or discoloration of the tooth should be removed and the dentin resterilized. This method, described in the *Dental Cosmos,* March 1911, was practiced for twenty-five years on patients under continuous observation and demonstrated its value in preserving the teeth.

When the cavity referred to above, prepared for filling and apparently clean, is subjected to laboratory tests, the reasons for subsequent decay are readily disclosed. In the tubules of the underlying dentin are found living organisms, usually a minute gram-negative diplococcus and streptococcus. If the tooth is filled at once, they continue slowly toward the pulp and, years later, cause calcification of the pulps or the development of pulp stones or alveolar abscesses. As in the case of cervical infections, they have been followed, incubated and demonstrated on microscopic slides, and have been found in the tissue of living pulps long before the pulps have become devitalized or putrescent. Here too is a source of systemic infection where access to the circulation is more direct than from a pulpless or so-called dead tooth.

If the cavity is not filled at once, but is sterilized for several days previous to filling, cuttings from the dentin in the floor of the cavity, which have been examined to the depth of one-eighth inch, about 3 mm., show the same organisms on slides, but none of them will grow when incubated. This sterilizing is accomplished by applying a solvent such as chloroform for opening the dentinal tubules, which alcohol will not do, and following it with a germicide under pressure of hard base-plate gutta-percha.

The organisms found in the tubuli beyond the extent of cavity preparations are a minute gram-negative diplococcus and *Streptococcus viridans.* They appear to be symbiotic and sometimes penetrate the pulp without causing a visible cavity. The streptococci appear to proliferate more rapidly than the diplococci after the pulp has been reached. This symbiotic relationship in dental infections has been associated with serious maladies; but this subject is beyond our province.

These diplococci have been under observation for several years, but, on account of their close association with the streptococci, it was very difficult to get them in pure culture for identification and classification. Finally, George R. Moffitt, M.D., director of the laboratory of the Harrisburg Hospital, succeeded in isolating them. The usual identification tests revealed that there was no organism the structure, staining, reactions, cultural

characteristics and serologic reactions of which were similar; nor had an identical organism ever been recorded, although they belong to the Neisseria. As a means of designation, they were referred to in the laboratory as *Neisseria caries dentium*.

Pulpless teeth, as a rule, should not be extracted, as every tooth is necessary for the proper functioning of the remainder. Even when alveolar abscess has developed, the teeth can be treated, filled and continued in usefulness with no danger to the system. Large areas around the apices showing *Streptococcus viridans, Streptococcus hemolyticus* and other virulent organisms have been restored to normal condition and the restored areas subsequently checked. Specimens incubated from the formerly infected apical areas have, at intervals of from two to ten years, shown negative results, no trace of the former infection being present.

Extracting the tooth will no doubt more quickly eradicate the infection, relieve the dentist of a feeling of further responsibility and end the patient's apprehension about "poisons" getting into his system. But the easiest way is seldom the best way, and, for normal patients, the loss of the tooth is far more serious than its retention, if the operator makes use of the facilities that modern bacteri-

LABORATORY CHARACTERISTICS OF NEW ORGANISM*

Sugar Reactions	Gram	Dextrose	Levulose	Galactose	Maltose	Lactose	Saccharose
Meningococcus (Neisseria intracellularis)	−	+	−	−	+	−	−
Pseudococcus (Parameningococcus)	−	+	−	−	+	−	−
Gonococcus (Neisseria gonorrheae)	−	+	−	−	−	−	−
Micrococcus catarrhalis (Neisseria catarrhalis)	−	−	−	−	−	−	−
Diplococcus crassus	+	+	+	+	+	+	+
Micrococcus pharyngis siccus (Neisseria sicca)	−	+	+	−	+	−	+
Diplococcus flavus	−	+	+	−	+	−	−
Pigmented coccus I (Neisseria perflava)	−	+	+	−	+	−	+
Pigmented coccus II (Neisseria flava)	−	+	+	−	+	−	−
Pigmented coccus III (Neisseria subflava)	−	+	−	−	+	−	−
Diplococcus caries dentium (Neisseria caries) 24 hr.	−	+	−	−	+	−	+
Diplococcus caries dentium (Neisseria caries) 48 hr.	−	+	+	+	+	−	+

Medium: Hiss serum water with Andrade indicator, to which is added the various sugars.

CULTURAL CHARACTERISTICS

Agar plate: Small, grayish white, round colonies.
Gelatin plate: Very small, punctiform colonies.
Endo-medium plate: No growth.
Human blood-agar plate: Small, grayish white, round colonies.
Dextrose-agar plate: Small, grayish white, round colonies.
Agar slant: The streak is made up of closely approximated, grayish white colonies.
Gelatin: Slight growth to bottom of stab. No liquefaction. No surface growth.
Bouillon: Turbid. No pellicle.
Litmus milk: Unchanged.
Potato: No growth.
Russell's double sugar: Slight pink tint in upper part. No color change in butt.
Loeffler's blood serum: Yellowish, raised and moist in 24 hours.
Yellowish, flat and dry in 48 hours.
Lactose bouillon: No gas.

*The organisms which affect sugars identically are differentiated by serological reactions or cultural characteristics.

ology and bacteriologic laboratories have placed at his command.

Many expositions of successful root-canal treatment and methods of retaining pulpless teeth have been made in the past twenty years by conservative thinkers, who are not inclined toward unconditional enthusiasm. In the *Dental Cosmos,* June 1934, Milton J. Waas, dental chief of the Pennsylvania State Department of Health, reported a comprehensive study of this subject.

Another indispensable factor in preserving the teeth, which cannot be considered here, is orthodontia. Each tooth should occlude with those of the other arch in exactly the way Nature intended or the natural cleansing mechanism will be interfered with and various abnormal and deleterious conditions will result.

The use of autogenous vaccines, which has been practiced extensively for about thirty years in the laboratory of the Harrisburg Hospital, has, in the past ten years of newer developments, been an important addition to the scientific procedures against disease. In their employment in oral infection, caries, alveolar abscess and systemic conditions accompanying the oral disease, the results have been such that any statement as to percentages would appear an exaggeration. There are almost no cases in which there are not definite beneficial results.

A boy of nearly 10 years had more than twelve cavities in his deciduous teeth, with several infected pulps. He could not masticate food without pain, and he was sickly and emaciated. An autogenous vaccine made from the causal organism was administered by the family physician. In order to prevent subsequent irregularity of the teeth, no tooth was extracted. Shortly after the vaccine therapy was completed, the patient began to improve in health and to gain weight. No new decay occurred and, at fifteen, he is a robust young man.

Another youth, aged 18, had sixteen cavities in his permanent teeth, one of them having reached the pulp of a first permanent molar. With autogenous vaccine therapy, his health was greatly improved. The infected molar was retained and no other cavity has developed in five years.

If a tooth is abscessed and there is a circumscribed area of infection, a certain amount of resistance to the invading organisms is indicated. If the local symptoms of infection appear acute and the area is inflamed and not circumscribed, with often a rise in temperature and a high leukocyte count, the patient is susceptible to the invading organism. Extracting the tooth will remove the source of infection and clear up the local disturbance, but it will not immunize the patient to the action of the organism. Removing the abscess and immunizing the patient with an autogenous vaccine will clear up the local condition, without loss of the tooth, and will protect the other organs from metastatic or secondary infection from the same organism.

CONCLUSION

It is essential for dentists to familiarize themselves with oral bacteria and laboratory technic, because every one of the lesions—recession of the gums, dentinal caries, alveolar abscess, pyorrhea alveolaris—that cause loss of teeth began with an invisible growth that could readily have been discovered with a microscope. If these invasions can be kept in mind, visualized by the operator and checked before the colonies of organisms become large enough to be seen or felt; if they are kept in subjection by dental care every month, and cavities and root canals in teeth already infected are treated with due observance of bacteriologic requirements, the conditions so deplorable in later life will seldom develop in our patients, many of whom now must end their days with artificial dentures and bridges, disfigured countenances and inadequate means of mastication.

200 Pine Street.

EVALUATIONAL DISORDERS AND CARIES—SEMANTOGENIC SYMPTOMS*

By L. G. Barrett, D.M.D., Hanover, N. H.

THE relation of evaluational disorders and caries appears to be an invariant one as deduced from my observation of approximately 10,000 mouths since 1924. This may be exhibited by example in the mouths of many Vermont farmers' wives, for instance.

Evaluational disorders are based upon "false-knowledge" well impressed thalamically from birth and incorporated in traditions and doctrines until the assumptions become established. The salt-pork and potato barrel of Vermont, as well as semantic injuries from political cruelties, etc., in the environment, can cause serious neuro-endocrine disturbances of the organism. These may be explained in terms of acid formation, of electrocolloidal dispersion, etc., but the fact remains that biochemical reactions follow and caries will be observed.

Those who may be interested in observing this relation to caries, and incidentally in improving the dentist-patient working relation to one of pleasure, have at their disposal the following symptomatology of semantogenic disorders. I suggest that all dental clinics operating for the acquiring of data on caries insert a separate sheet, in color, with these four headings on it and briefly train the observers in the technic of picking up these rather subtle but powerful factors in caries: 1. Identifications. 2. Allness. 3. Hypertonicity. 4. "Undelayed" reactions.

Explanation becomes necessary, and methods will be given for overcoming the symptoms by reevaluation of old assumptions.

IDENTIFICATION

Conscious distinction is possible between the two levels of non-verbal facts, the objects of sense perception (for example, what we see, which is known as the macroscopic level) and the submicroscopic level of processes: electronic, physicochemical, electrocolloidal processes, etc., which we know through modern scientific advance. We can illustrate this distinction by calling attention to the fact that an electric fan appears as a disk even to a camera while the fan is in motion. Actually, there are only rotating blades, not the disk abstracted by our nervous system. Our eyes and most cameras

*For the orientation and methodology of the accompanying analysis and formulations of the problems of dental caries as related to evaluational disorders of the human nervous system, the author acknowledges indebtedness to Count Alfred Korzybski, with whom he has studied in various seminars and private conferences for several years. He continues: "The general theory of evaluation and the extensional method, known as general semantics, are systematically presented in 'Science and Sanity, an Introduction to Non-Aristotelian Systems and General Semantics,' by Alfred Korzybski, Science Press Printing Company, Lancaster, Pa., 1933. I am also indebted to Prof. Wendell Johnson, of the psychological clinic, State University of Iowa, for the term 'semantogenic.' Much general illustrative and non-dental material used in this paper is taken from chapters 6 and 7 of Professor Johnson's Monograph: 'Language and Speech Hygiene —An Application of General Semantics,' published by the Institute of General Semantics, 1939. Readers are referred to this monograph for an abbreviated presentation of general semantics as an introduction to the subject for clinicians."

simply fail to register the rotating blades as such. The structure of our nervous systems, unaided by microscopes, etc., can only record mass aggregations or effects, comparatively static "objects," such as a "cloud" for example, while actually an electro-colloidal process is going on. We see only objects or abstractions from the processes on the submicroscopic level. Objects seen under a microscope are still on the objective level of sense perception, though we abstract more and different characteristics through this extra-neural means. Certainly the object which we see on a plate before us which we label, for instance, "apple pie" is of less survival value than the physicochemical process of "pie" digesting within us.

Also, we can distinguish between an object and the mental image we may carry of an object. The image is an abstraction from the object and of less survival value. The verbal label or description is even more abstract and has no food value. Inferences are more abstract than descriptions, more characteristics having been omitted. The giving of equal value to these different levels of abstraction is what takes place when one identifies them or fails to distinguish the difference between the word "apple-pie" and the actual pie. Salivation will even take place because of such delusional evaluations! Also, endocrine activity is induced by words in a person who confuses words with objects or events. This is not true if the evaluation is proper. Consider the word "drill" and its comparative harmlessness beside the actual steel object whirling in a carious tooth. Persons who make such identifications present the attitude of "allness," the second symptom.

ALLNESS

Such persons as those mentioned above simply act as if the word "apple-pie" were the same as an actual piece of this food. Armed with their highly verbal knowledge, they assume attitudes of authority, become dogmatic and then very indignant, disappointed and hurt when contradicted or challenged. Or they act as if, being able to describe or having a name for a thing, they know all about it. They often evolve theories, make plans, join clubs and start movements without bothering to examine the actualities that they are presumably talking about. The person who refuses to eat eggs is not only responding to egg_1 as if it were identical with egg_2, but is also identifying the macroscopic with the microscopic and submicroscopic egg. That is, he is acting as if, having seen or smelled or tasted the egg, he knew all about it. It might be said that the place to evaluate an egg properly is in the stomach and not on the plate.

There once was a little boy who would eat nothing but fruit cake. He was a hospital patient, of course. It goes to show how far such an identification and attitude of allness can be carried. It is of interest to consider how many cases of stomach ulcers, anemia and various digestive disorders are semantogenic in this sense. This attitude of allness can effectively block the possibility of advancing science generally. We have the patient who will have nothing to do with novocaine, as "it never works," "makes her ill," etc. This attitude of allness then is usually recognized as dogmatism, stubbornness, the closed-mind attitude, a conservative and reactionary tendency, self-righteousness or relative unconditionality of response. To have highly conditional responses is to have quite the opposite of highly conditioned responses. The attitude of allness may be thought of also in terms of rigidity of reaction patterns, being set in one's ways, etc.

The next related symptom is that of varying degrees of muscular tension over and above that necessary for adequate adjustive behavior.

HYPERTONICITY

From a practical clinical point of view,

we may distinguish between patients who present muscles which are "rubbery" or stiff and those that feel "cottony" or relaxed. The triceps is quite easy to examine for these conditions. In the male, the trapezius will often be found tense if the patient is much on the defensive, has little actual defense or is suffering real adjustment difficulty. The female tends to register this defensiveness or tension in the abdomen. The hands are quite readily available for inspection and a relaxed hand feels soft, flexible, pliant, warm and relatively dry. A hypertonic hand feels stiff, resistant to passive flexion and extension, hard and often clammy or cold and moist.

"UNDELAYED" REACTIONS

The tendency to show undelayed reactions is consistent, of course, with a condition of hypertonicity. We rather expect a tense individual to be jumpy, nervous, irritable or quick to take offense—to show hair-trigger reactions generally. Excessive impulsiveness, a tendency to "fly off the handle," jump to conclusions, etc., point to this undelayed reaction symptom. It is the relatively relaxed individual whom we rather expect to be thoughtful, patient, tolerant, to suspend judgment, to consider the many sides of a question, to be collected and unexcited in an emergency.

The general picture, then, of behavior in which there is evidence of identification, allness, hypertonicity and "undelayed" reactions, appearing together, is a consistent one, and one with which we are familiar, although we may not have been accustomed to speaking of it in exactly those terms. Attention is called to this syndrome in patients and its relation to the objective, clinically more obvious, but no less observable caries-hypersensitivity group which we have somehow come to consider as having some mysterious cause. The only mystery is our lack of ingenuity in discovering the relations between the isolated facts, details of which we have studied for years.

If it is found experimentally by collecting the data that a definite relation does exist between caries and the symptoms here suggested, a prediction based upon organism-as-a-whole observations in a private practice and in a few outpatient clinics will be borne out. A means of dealing with factors in caries will be afforded and we shall no longer be restricted to late symptoms in the process. The methods of treatment for preventive dentistry will become general methods involving the organism as a whole. Extensionalization will be the training to overcome identification. I use a small metallic device which the patient can hold and which conveys to him thalamically as well as verbally the difference between the verbal "drill" and the nonverbal object, drill. The principle of uncertainty can be readily conveyed as more desirable than "allness" by means of this device. The patient's signal reactions become symbol reactions, and they are delayed, controlled.

Regarding optimal tonicity, there is now available the work of Jacobson on muscular relaxation, as well as a more vascular approach to the problem, in the more recent neurosemantic relaxation of Korzybski. This may be readily taught the patient and practiced by him.

Conditionality of response is obtained by delaying reactions. This throws energy through the cerebral cortex; and glands are brought under proper control. The patient becomes adjusted to the work, the dentist and the drill. This is accomplished the moment consciousness of abstracting as a normal, unavoidable function of the nervous system is realized.

Certain mechanisms in our education and training unfortunately tend toward just the opposite, but some knowledge of ourselves is necessary if optimum function is to be expected. This is a matter of readily verifiable fact. Rotate the blades of an electric fan. You "see" the disk. All life proceeds on the level of

electrocolloidal processes—at the least, it is submicroscopic, but we see only the object. Of this we create a mental image, and, for the sake of expediency, give it a verbal label, whether written or spoken.

We may go on abstracting, each time leaving out many characteristics, and pass from description to inference and to conclusions. We try to reverse this natural order when we identify verbal entities with non-verbal objects or processes. If we evaluate the mental image of the verbal definition of "dentist" or "drill" as if it were a fact of immediate experience before we even find the office, it may be predicted that there will be neuroglandular function that would not be present if the office were found first, investigation made, the drill experienced in the hands of the new operator and our verbal descriptions be made and conclusions based upon facts of experience to date rather than upon tradition. Tradition being necessarily historic, constant revision to date is necessary to maintain it accurately.

It is predicted that the recording of these few or several semantogenic symptoms of fundamental significance by several unbiased individuals in a number of clinics will result in the acquiring of data on factors in the study of caries of use in the practical treatment of that condition. This statement is made only after several years of most careful study. I have available a large amount of detailed information for the use of those interested in particular aspects of this study. In general, it is desirable simply to record the symptoms for a while on a case-history sheet and, by a simple check mark, to indicate whether present and to what degree. Later, coordination with the patient's dental record may be made, and then treatment from this general organism-as-a-whole approach may be given by a few interested students. In time, recoordination with the dental examination can be made for the recording of changes in the rate of carious deorganization. Specific cases in my practice are available to those interested in direct observation of semantogenic factors in dental caries.

SUGGESTED FORM FOR USE IN COLLECTING DATA ON SIGNIFICANCE OF SEMANTOGENIC FACTORS IN "DENTAL CARIES"

Form No.
(colored)

Name of clinic
Address, etc.

Dental Department
Caries Investigation

Semantogenic Disorders
Symptomatology
1. Identifications
Examples noted:
(Confusion of description with inference, words with objects, processes with words, etc.)
2. Allness
Attitudes noted
(Dogmatism, stubbornness, self-righteousness, closed-mindedness, etc.)
3. Hypertonicity
(Whether generally tense or relaxed, the degree of muscular tension noted in the triceps, trapezius, gluteous and iliocostal muscles, abdomen, hands, etc.)
4. "Undelayed" reactions
(Whether impulsive, irritable, jumpy, nervous, quick to take offense, set, tendency to jump to conclusions, rigidity of reaction patterns, etc.)

The recordings may be made by plus or minus marks, underlining, writing in observations during work, etc. It makes for accuracy to use visual and non-verbal methods of observing supplemented with as few questions as possible. If the facts are present, they are simply checked. In coordinating the data with the macroscopic carious symptoms present, yearly observations are indicated where possible. Collection of clinical data for several years is desirable for valid statistical results.

Lang Building.

POSSIBLE CARDIOVASCULAR CHANGES IN LOCAL ANESTHESIA

By Paul P. Pickering, D.D.S., M.S.; C. J. McCooey, D.D.S.; H. P. Steinmeyer, D.D.S., B.S., and Arno B. Luckhardt, Ph.D., M.D., Chicago, Ill.

THE administration of local anesthetic solutions for dental operations frequently results in unpleasant sensations on the part of the patient. There have been some reports (mostly personal) to the effect that patients suffering from hyperthyroidism are particularly sensitive to anesthetic solutions containing epinephrine. The present investigation was undertaken to study the action of these solutions on the cardiovascular system as manifested by blood pressure changes. The hemodynamic effects of procaine-epinephrine* solutions on normal dogs was compared with reactions evidenced by animals in an experimental hyperthyroid state.

The literature on this subject contains reports indicating that procaine-epinephrine mixtures do affect the cardiovascular system. Miller[1] reported a series of cases in which an increase in heart rate and extrasystoles followed injection of procaine-epinephrine. Electrocardiographic findings were the basis for this conclusion. Tainter *et al.*,[2] in a clinical comparison of a 2 per cent solution of procaine and a 4 per cent solution of borocaine, each containing epinephrine 1:50,000, reported that small increases in pulse rate, respiration and systolic blood pressure followed the use of each solution; which they attributed to the epinephrine content of the anesthetic mixtures; also, that, with borocaine-epinephrine, there was a greater incidence of additional systemic reactions; namely, "nervousness, tremors and fainting."

Miller and Stuart[3] observed increases in the blood pressure, pulse rate and respiration of patients subjected to administration of local anesthetic solutions. These workers stressed the importance of using a minimum concentration of epinephrine or one of the weaker vasoconstricting agents in cases of angina pectoris, arteriosclerosis or hyperthyroidism.

Tainter and Throndson,[4] in experimental studies on anesthetized cats, pointed out that of the several vasoconstrictors used with procaine, namely, cobefrin 1:20,000, neosynephrine 1:1,-148 and epinephrine 1:50,000, the last caused less elevation in the blood pressure when injected intravenously. In a subsequent paper, Tainter *et al.*,[5] on the basis of a clinical study, reported that the injection of procaine-epinephrine increased the pulse rate and the systolic blood pressure. They found, furthermore, that these reactions were more marked with epinephrine 1:25,000 than with other vasoconstrictors (cobefrin 1:10,000, neosynephrine 1:2,500) or more dilute concentrations of epinephrine.

In a preliminary report,[6] we have shown that subgingival injections of procaine-epinephrine often cause marked

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From the Department of Physiology and the Walter G. Zoller Memorial Dental Clinic, University of Chicago.

*The terms "procaine-epinephrine," "epinephrine" and "procaine" used in this paper refer to the hydrochloride.

increases in the blood pressure of dogs under general (paraldehyde) anesthesia.

On the other hand, Borg[7] concludes, from a clinical study, that any changes in the blood pressure and pulse rate which may occur before, during or after various dental operations are not caused by the introduction of the anesthetic solution.

The views on hyperthyroidism and procaine-epinephrine administration have been summed up by Archer,[8] who states that, in his opinion, epinephrine in procaine solutions may precipitate "thyroid crises" in patients suffering from hyperthyroidism. This observation would fall in line with the hypothesis underlying the Goetsch "epinephrine hypersensitiveness test" and the work of Levy.[9] Levy reported that the intravenous injection of thyroxin increased the efficacy of epinephrine as a pressor agent. He assumed, however, that the thyroxin was immediately effective; whereas Kunde[10] has shown that the effects of intravenous injection of thyroxin are not demonstrable for from seven to twelve hours after introduction.

The Goetsch[11-14] test is based on the hypothesis that an oversecretion of the thyroid hormone renders the sympathetic nervous system more sensitive to the action of epinephrine. In Goetsch's studies, patients at rest were examined for nervous symptoms and the temperature, pulse rate, blood pressure, size of pupil and respiration were determined. These patients were then given deep subcutaneous injections of 0.5 cc. of 1:1,000 epinephrine solution. The foregoing observations were repeated. Goetsch states that there was usually an early rise in the systolic and a fall in the diastolic pressure, accompanied by an increase in pulse rate and an exaggeration of nervous symptoms in cases of hyperthyroidism. Normal persons did not evince such reactions; neither did patients with incipient pulmonary tuberculosis, psychoneurosis, neurasthenia or hysteria. In fact, the test was credited with differential diagnostic value in cases of incipient pulmonary tuberculosis or hyperthyroidism.

Sandiford,[15] who subjected the Goetsch test to a clinical study, and Marine and Lenhart,[16] who investigated the effect of subcutaneous injection of adrenalin on normal and thyroidectomized rabbits, could find no relation between the intensity of adrenalin reaction (determined by oxygen consumption) and the degree of hyperthyroidism or hypothyroidism.

Lieb and Hyman,[17] using pithed cats, were unable to demonstrate an augmentation of adrenalin response following the administration of the active principle of the thyroid gland.

Difference in injection technics may explain, in some part, the inconsistency of results from studies on epinephrine sensitization. Luckhardt and Koppanyi[18] found that, in dogs, a striking pressor response from the subcutaneous injection of epinephrine was obtained only if the injection site was massaged following deposition of the solution.

Chamberlain,[19] in this laboratory, studied the hemodynamic effect of epinephrine on normal dogs and on dogs in a hyperthyroid state. In one series, there were fourteen normal and fourteen thyrotoxic dogs. From 2 to 3 cc. of epinephrine (1:1,000) was injected subcutaneously (area massaged) and the blood pressure was recorded. The results showed no consistent variation between the two groups. In another series, six dogs, not under general anesthesia, but solely under the quieting influence of morphine sulphate (gm. 0.015), were injected intravenously with various quantities of epinephrine 1:500,000 while the blood pressure was recorded. The same six dogs were then put into an experimental hyperthyroid state, after which the foregoing procedure was repeated. An average of the blood pressure changes in the normal and in the hyperthyroid state showed no significant difference. (Table 1.)

EXPERIMENTAL METHODS

In the present study, two groups of dogs were used: (a) nineteen normal animals and (b) nine animals in an experimental hyperthyroid state. Both groups were selected indiscriminately as to size and sex. However, males predominated and the weights ranged from 6 to 20 kg. All the experiments were instituted while the animals were under paraldehyde anesthesia (2 cc. per kilogram of body weight, orally administered). In most instances, owing to the light anesthesia induced by the paraldehyde, ether was supplemented for the insertion of the tracheal cannula and the carotid artery cannula. After these operations, ether administration was discontinued, since etherization diminishes the pressor responses to epinephrine, according to the report of Rous and Wilson,[19] confirmed by Koppanyi and Luckhardt.[20]

In most cases, the vagi were sectioned or atropine sulfate was administered to eliminate cardio-inhibitory effects. Records of the blood pressure and respiration were made on the kymograph in the usual manner.

Procaine (2 per cent) with epinephrine (1:25,000) was used in all injections (total volume per injection, 2 cc.). The sites chosen for introduction of this solution were those commonly used in dental operations: (1) the anterior palatine foramen; (2) the region of the posterior palatine foramen; (3) the region of the mandibular foramen, and (4) the mental foramen of the mandible.

The order of the injections into the different sites was varied. The actual injection time, i.e., the time required for the introduction of the 2 cc. volume into a given site, varied only slightly. Control injections of physiologic solution of sodium chloride were made in the same areas in the same manner.

Experimental thyrotoxicosis was induced in the second group of animals by the daily intravenous administration of thyroxin (0.5 mg./kg.) until definite hyperthyroid symptoms were observed. Kunde's[10] excellent work has proved that intravenous injections of thyroxin will unquestionably produce experimental hyperthyroidism in dogs receiving this treatment. Kendall[21] wrote that from 1 to 10 mg. of thyroxin per day will produce hyperthyroidism in the dog.

The dogs selected for the hyperthyroid group were observed for a control period of from ten to fifteen days. During this time, pulse rate, rectal temperature, body weight and water and food intake were recorded daily. After the control period, thyroxin (0.5 mg. per kilogram of body weight) was administered intravenously each day. This medication was continued until a consistent increase in pulse rate, taken under standard conditions, was attained. In most instances, the animals lost weight and water intake increased as the thyroxin medication was continued. Body temperature varied in both control and hyperthyroid periods. The thyrotoxic animals appeared to be easily excited and showed a tendency to move about unceasingly in their cages. Diarrhea and

TABLE 1.—COMPARISON OF BLOOD PRESSURE RISES FOLLOWING INTRAVENOUS INJECTION OF EPINEPHRINE INTO NORMAL AND HYPERTHYROID DOGS.

	Blood Pressure Rise Following Epinephrine Administration			
Intravenous 1:500,000	0.1 cc.	0.2 cc.	0.5 cc.	1.0 cc.
Average of 6 dogs — normal	7 mm. Hg.	11.6	18.3	27.3
Average of same dogs — hyperthyroid	7 mm. Hg	9.3	15.3	25.0

(Chamberlain)

tenesmus were noted in the majority of the animals. When the animals showed restlessness and loss of weight with no decrease in food consumption and, more important, developed a definite tachycardia, they were considered to be in a hyperthyroid state and were subjected to the same procaine-epinephrine studies as were the normal group.

RESULTS

The results of these experiments are shown in Table 2.

In some instances, as shown in the accompanying figure, the blood pressure was markedly increased by the introduction of the procaine-epinephrine into the anterior palatine foramen.

Table 2.—Comparison of Blood Pressure Changes from Introduction of Procaine-Epinephrine into Normal and Thyrotoxic Dogs, with Sites of Injection Indicated

Solution	Volume of Injections	Number of Animals	Average Blood Pressure Rise			
			Anterior Palatine	Posterior Palatine	Mandibular	Mental
Normal Group						
Procaine 2% with Epinephrine 1:25,000	2 cc.	19	27.0%	2.2%	3.1%	10.4%
Thyrotoxic Group						
Procaine 2% with Epinephrine 1:25,000	2 cc.	9	20.5%	6.2%	6.0%	9.0%

COMMENT

Inspection of Table 2 plainly indicates that the injection of procaine-epinephrine into animals in an experimental hyperthyroid state as compared with a normal group of animals makes no consistent and significant difference in blood pressure changes. Results from a larger group of animals would, no doubt, have yielded more strikingly negative data. The possible psychic (cerebral) effect of the absorption of epinephrine was precluded by our mode of experimentation, since all experiments were conducted with the animals under general anesthesia.

It may be permissible, however, to hazard a guess as to what the results might have been had these two series of experiments been performed on unanesthetized animals. To leave out of account propensities toward an elevation of the blood pressure due to excitement and fear resulting from manipulation of the animals preparatory to making the injections, the injection of epinephrine itself increases the irritability of the cerebrospinal nervous system, and this action alone would tend to raise the blood pressure. Furthermore, the subjective symptoms of apprehension and impending danger engendered by the sudden and pronounced elevation of blood pressure from the peripheral action of epinephrine might contribute to a pressor effect via vasoconstriction of central medullary origin. Although these additional factors (in elevating the blood pressure above that effected by the peripheral action of epinephrine) would affect both series of animals, the hyperthyroid animals, because of a marked increase of nervous irritability due to the administration of thyroxin, might be expected to react quantitatively in a more pronounced manner in comparison with the normal animals.

However that may be, it is generally conceded that procaine-epinephrine solutions have a tendency to increase the pulse rate and systolic blood pressure in anesthetized animals. Our own observations do not lend support to the position taken in this matter by Borg,[7] who attributes the increase in blood pressure and pulse rate, which occurs in patients undergoing local anesthesia, to psychic conditions. The methods employed by him in determining the blood pressure changes in patients under his observation may furthermore be criticized, since the blood pressure measurements on his patients were not continuous. He recorded the blood pressure prior to the injection of the anesthetic solution and made subsequent measurements approximately two or three minutes following the actual administration of the solution. In our study, all pressor effects from the epinephrine followed well within one minute the injection of the solution. (Fig. 1.) The blood pressure then rapidly returned to normal, as might well be expected in consideration of the transitory effect (presumably due to rapid oxidation) of epinephrine administration on the general blood pressure. This would explain to some extent the lack of consistent and significant cardiovascular changes observed by Borg.

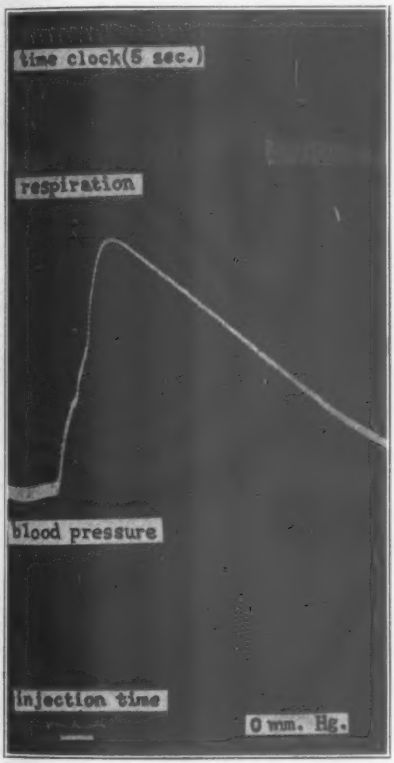

Fig. 1.—Blood pressure rise which followed injection of procaine (2 per cent) and epinephrine (1:25,000) into anterior palatine foramen. The peak of the rise occurred within thirty seconds. The total rise above normal was 110 mm. of mercury. This was the highest rise noted in either group.

Our own results tend to confirm the investigations of Chamberlain; Sandiford; Marine and Lenhart, and Lieb and Hyman cited above, in that we found no indication that experimental hyperthyroidism renders the sympathetic nervous system more sensitive to the pressor action of epinephrine.

SUMMARY AND CONCLUSIONS

In a comparative study of the magnitude of the cardiovascular changes following the injection of procaine-epinephrine solutions into sites commonly used in dental operations, two groups of animals were employed: nineteen normal animals and nine animals in an experimental, hyperthyroid state.

Confirming our own previous studies as well as the observations of others, we find that

1. Normal animals exhibit rather marked pressor responses to the injection of procaine-epinephrine solutions.

2. Under the same conditions animals in an experimental hyperthyroid state show no marked deviation in blood pressure changes from the normal group. We therefore conclude that the sympathetic nervous system of thyrotoxic animals

shows no increased sensitiveness to the epinephrine (procaine-epinephrine) solutions which distinguishes them from normal animals.

3. These striking elevations of blood pressure were obviously not due to psychic conditions since all the procedures were carried out with both sets of animals under general (paraldehyde) anesthesia.

4. It is quite possible (for reasons stated under "Comment") that our hyperthyroid animals, as compared with the normal animals, might have shown more pronounced effect had they been unanesthetized.

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BITE-PLATES: THEIR INFLUENCE ON THE GROWTH OF THE MANDIBLE

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AS is well known, the bite-plate was introduced in orthodontic practice about the year 1880 and has been used since that time as an adjunct in the treatment of malocclusion. Clinical experience has repeatedly demonstrated that changes are produced by the use of the appliance, but there has been at the same time a sharp variance in opinion as to the kind of changes induced, some orthodontists being even rather doubtful as to its usefulness. (Grieve.[1]) We find, for example, one school of thought[2] which insists that application of the bite-plate causes depression or intrusion of the lower anterior teeth, with no elevation whatever in the molar and premolar area. On the other hand, I,[3] among others, have maintained the contrary view; namely, that the bite-plate does very commonly cause appreciable elevation in the molar and premolar regions, and moreover that there is no, or is very rarely any, attendant depression of the lower incisors. Strangely enough, no factual evidence of any kind had been presented in support of either contention until my recent contribution.[3] The following is an elaboration of essentially the same material, now possible of additional interpretation and corroboration.

Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

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THEORETICAL CONSIDERATIONS

A review of the theoretical basis of the problem may well precede the statistical presentation.

It was Greig[4] who said "Conformity in the pathology of the same variety of tissue throughout the body is strong presumption of the correctness of any theory of its growth, disintegration and repair, and to this the pathology of bone is no exception" (p. 14). If this is so, as we believe it is, knowledge gained in the development of bone in any part of the body (pertaining to growth, disintegration and repair) should be applicable directly and indirectly to the mandible and maxillae surrounding the teeth.

In the classical studies of bone structure by Jansen,[5] Macewen[6] and P. D. F. Murray,[7] there is agreement by all in the contention, as expressed by Murray, that "increased pressure always leads to strengthening of the bony structure" (p. 133). As a result of introduction of the bite-plate, the anterior teeth are actually subjected to increased pressure because the posterior teeth are totally relieved of occlusal forces. Hence, according to the authorities cited above, this increased pressure anteriorly should perforce tend to strengthen the investing bone. This idea is obviously contrary to the premise of Mershon that a bite-plate causes intrusion of the lower incisors.

Macewen[6] has further shown that bone growth takes place in the direction of least resistance. With the posterior teeth free of occlusion as a result of applica-

tion of the bite-plate, an area of diminished resistance is obviously created, which should cause the bone structure about the lower posterior teeth to grow in an upward direction (that of least resistance) and the bone structure about the upper posterior teeth to grow downward (direction of least resistance). Clinically, this phenomenon has actually been observed in cases wherein teeth have been freed of occlusion by the extraction of their antagonists. In all such cases, we find a growth of the bony structure which carries the teeth into the space left by the missing antagonist. (Fig. 1.)

As a matter of fact, Oppenheim[8] has demonstrated that it is possible to cause

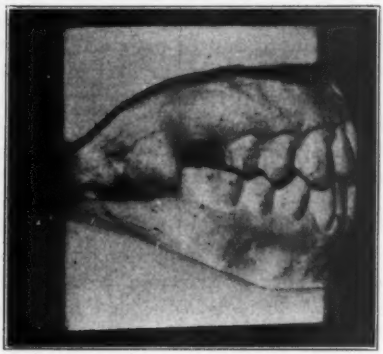

Fig. 1.—Downward growth of bone structure caused by extraction of opposing teeth.

depression of the teeth in such cases of supraclusion. A microscopic study of teeth which had grown past the line of occlusion because of lack of occlusal contact shows that the trabecular structure has been reduced to a very marked extent. In these cases, we find that the bone structure which has not received sufficient functional stimulation cannot withstand occlusal pressure. In the words of Oppenheim[8]:

> Owing to the lack of occlusion for a long time, the bone has suffered changes, as the investigations of Kellner and Kronfeld show us, thus creating most favorable conditions for our procedure of shortening. As we see in Figure 2, on the left (the functionless molar), the spongiosa, in comparison with Figure 2, on the right (the functioning molar), is considerably rarefied—even reduced to some single bone spicules. This condition is found not only in the intraradicular septum, but also in the area surrounding the apices, which are embedded in the broad-meshed spongiosa. "It is preponderantly a retroalveolar spongiosa, the stage of which is conditioned by the function."

Kronfeld reports on the same changes and says, in comparing the two pictures that represent a functionating and, respectively, a non-functionating upper wisdom tooth (p. 348), that about the functionating tooth is "well developed alveolar bone and supporting bone." About the non-functionating, his report runs as follows: "Thin alveolar bone.

Fig. 2.—Bone structure about functionless molar (left) and bone structure of functioning molar (right). (From Oppenheim, after Kellner.)

The supporting bone has almost entirely disappeared and is replaced by fat marrow."

We are justified, therefore, in concluding that bone structure, when subjected to functional stimulation, organizes, and trabeculae are formed to resist pressure. When it is deprived of functional stimulation, retrograde changes take place.

Jansen[5] has shown that bone will tolerate a tremendous amount of force when it is applied in the direction in which the bone would normally resist it. While it seems likely that a bite-plate causes an increase in pressure on the

anterior teeth, the line of direction of this pressure is along the long axis of the teeth and in the direction in which the bone supporting these teeth would normally resist it. Although it is unquestionably possible for the alveolar structure in the anterior region to grow beyond the normal occlusal plane, if this additional bone receives sufficient functional stimulation, it should, according to the theories of Jansen, withstand the occlusal force even though this force might be somewhat in excess of normal. This fact was recognized by Angle as far back as

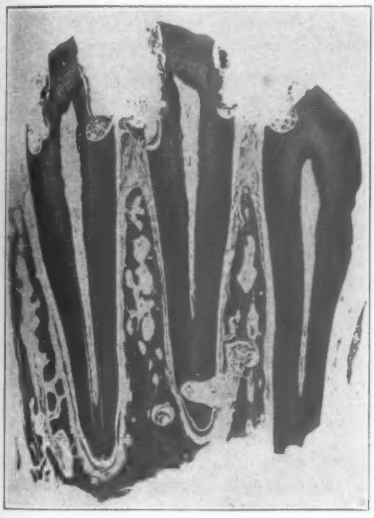

Fig. 3.—Bone structure about three incisor teeth that were subjected to influence of bite-plate for period of eleven weeks. The density of the bone is evident.

1907 and is mentioned in his description of Class II, Division 2 cases[9] (p. 514). He says, "Unlike the condition of the other division (Class II, Division 1), the incisors are less elevated in their sockets (Class II, Division 2), owing, probably, to their being better able to functionate." On the basis of this opinion, one must arrive at the conclusion that elevation in the molar and premolar area is to be desired. However, Angle seems to have been of the opinion that in Class II, Division 1, the incisor teeth are definitely elevated in their sockets. When one reaches the conclusion that the incisor teeth are elevated, it is but natural to attempt to depress them. While attempting to analyze the influence of bite-plates on the lower anterior teeth, I was led into a study of the conditions which permitted a depression of the teeth.

FACTUAL EVIDENCE

As was pointed out in the beginning, there has been an astonishing dearth of real evidence on the problem. In an effort to determine what actually takes place when the bite-plate is used and the reasons for the changes that occur, I

Fig. 4.—Section of bone before preparation for microscopic examination.

started an investigation three years ago. Measurements were taken with sliding calipers; first, from the incisal edge of the lower central incisor teeth to the inferior border of the mandible; second, from the infradentale to the inferior border of the mandible, and, third, from the occlusal surfaces of the lower first permanent molars at the junction of the buccal and occlusal surfaces directly over the buccal groove, to the inferior border of the mandible. Observations were made on cases before and after application of the bite-plate. Measurements were also taken on a second group; namely, persons who had presented themselves for treatment in the Orthodontic

Clinic of the New York University, College of Dentistry, but who had not yet received any treatment whatever. Comparison of these two groups should clearly indicate the relative changes induced by the bite-plate.

The cases in which the bite-plate was to be used were[3]: 1. Those which exhibited no curve of Spee, but showed rather a flat occlusal plane in the molar and premolar area. In these cases, the anterior teeth are on a much higher level. 2. A few of those cases in which the action of the appliance for correction of the malocclusion in the lower jaw would have created a force directly opposite to that engendered by mastication. In these cases, the bite-plate kept the posterior teeth out of occlusion, in consequence of which the appliance in the lower jaw created a direction of force free from the antagonizing occlusal force, to an extent that the lower teeth were not subjected to opposing forces.

The number of cases treated by means of the bite-plate is small, twenty-nine in all. However, the fact that the mean figures are based on actual increments in the same individuals, as well as the consistent character of the data, leads me to believe that the results are essentially valid.

It should also be mentioned that data on the upper face height, nasion to prosthion, and total face height, nasion to menton, are included in the analysis.

Table 1 gives the number of subjects manifesting an increment, or decrement, and the extent of each, in the several characters considered. The average interval of time between measurements in these cases was 9.8 months, and the actual time the bite-plate was in use was on the average only 5.9 months. Both sexes are included, a permissible procedure when increments and no absolute dimensions are considered, the combination being resorted to in order to attain a large and hence more reliable grouping.

As to the meaning of the figures, two highly significant facts especially stand out: 1. During the application of the

TABLE 1.—DISTRIBUTION AND MEANS OF INCREMENT IN VARIOUS HEIGHTS OF FACE AFTER USE OF BITE-PLATE (BOTH SEXES)*

Increment Mm.	LLM-LBM† No.	%	RLM-LBM No.	%	LI-LBC No.	%	Inf.-MENT. No.	%	NAS.-PROS. No.	%	NAS.-MENT. No.	%
−1					3	10.7	2	7.4				
0	4	13.8	6	21.4	16	57.1	16	59.2	9	33.3	1	3.7
1	10	34.5	6	21.4	7	25.0	5	18.5	1	3.7		
2	6	20.7	10	35.7	1	3.6	2	7.4	8	29.6	3	11.1
3	8	27.6	4	14.3	1	3.6	1	3.7	4	14.8	3	11.1
4	1	3.4	2	7.1			1	3.7	4	14.8	5	18.5
5–6									1	3.7	9	33.3
7–8											4	14.8
9–10											1	3.7
11–12											1	3.7
Total	29	100.0	28	99.9	28	100.0	27	99.9	27	99.9	27	99.9
Mean (Mm.)	1.7		1.6		0.5‡		0.4‡		1.9		5.1	

*The average interval between measurements was 9.8 months, the time the bite-plate was used being on the average 5.9 months.

†LLM-LBM, lower left molar to lower border of mandible; RLM, right lower molar, LI-LBC, lower incisor (incisal edge) to lower border of chin; Inf.-ment., infradentale to menton; nas.-pros., nasion to prosthion; nas.-ment., nasion to menton.

‡Excluding the cases with decrement.

bite-plate, elevation or growth upward in the molar region of the mandible does occur to an appreciable extent (from 1 to 4 mm.) and in more than 80 per cent of the subjects. 2. Despite use of the bite-plate, in almost 60 per cent of the cases there was no change whatever in the anterior portion of the mandible (incisal edge of lower incisors to chin, as well as infradentale to menton). In more than 30 per cent of the cases, there was actually increment, as much as 3 mm., in this area, and in only 3 cases, or a scant 10 per cent, was there apparent depression of the lower central incisors to the extent at most of 1 mm. The three latter cases will be further analyzed later. For the moment, it is sufficient to emphasize the two facts just demonstrated; namely, that, with use of the bite-plate, there is concurrent growth in the molar region, while depression of the lower incisors is at best a relatively rare occurrence and very slight.

As regards the average amounts of growth, it is exceedingly interesting to note the practically identical growth in the height of the mandible at the molar region on the right and left sides. Furthermore, it is noted that the growth in the molar region of the mandible is more than three times as great as in the incisor or chin region. In other words, there is actually relative (to the incisor region) elevation as well as absolute growth in the molar areas. Also of interest is the corroborative average increments both in the infradentale to menton and lower incisor to lower border of chin dimensions. Note may be made of the substantial mean growth in the height of the upper face and in total face height.

The question may arise, however, as to whether as great or greater growth would not have occurred under natural conditions. Fortunately, as described earlier in the paper, similar metric observations, as in the bite-plate cases, were obtained (by the same men) on subjects who had no orthodontic treatment whatever. Moreover, corresponding data of Smyth and Young[11] and Young *et al.*[12] on subjects with normal occlusion or Class II malocclusion have been adapted for comparative purposes. Comparison of growth in bite-plate cases and non-treated subjects is thus possible, and this is made in Table 2. It may be mentioned that the bite-plate cases were divided according to sex (about equal in number) for the sake of correspondence with the other data.

TABLE 2.—AVERAGE ANNUAL INCREMENT IN VERTICAL DIMENSIONS OF FACE IN SUBJECTS USING BITE-PLATE AND SUBJECTS HAVING NO ORTHODONTIC TREATMENT

Annual Mean (Mm.)	LI-LBC		LLM-LBM		RLM-LBM		Inf.-Ment.		Nas.-Pros.		Nas.-Ment.	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
1. With bite-plate (NYU)	0.5	0.5	1.4	2.3	1.6	1.6	0.4	0.9	2.1	1.7	4.9	5.4
2. Without bite-plate (NYU)	0.8	0.7	0.8	0.5	0.8	0.7	0.6	0.6	0.8	0.9	1.7	1.5
3. English normal	0.7	0.7	0.8	1.0							1.7	1.9
4. English Class II	0.6	0.8	0.6	0.8							1.6	2.0

Note: Age range 1, 9.5 to 18 years; 2, 8 to 19 years; 3 and 4, 8 to 13 years.

The results are highly instructive. It is at once apparent that mean growth from the lower central incisors to the inferior border of the mandible is virtually the same in bite-plate cases and cases in which the bite-plate was not used. A very similar situation is discerned in the comparable infradentale to menton dimension. Remarkably enough, there seems to be in this area little differ-

ence in average growth between normal and abnormal occlusion.

Turning to the molar region, we find the picture totally different. In the bite-plate cases, growth upward in the mandible has been on the average twice as great as in any of the groups in which the bite-plate was not used. In other words, application of the bite-plate definitely tends to accelerate increment in the molar regions of the mandible. The much larger increment in the total face height (nasion to menton) also suggests more growth downward in the molar regions of the maxillae as compared with conditions in subjects in which the bite-plate was not used. To be sure, the results based on the more or less unreliable nasion as one of the landmarks must perforce be considered with caution. Nevertheless, the net excess of increment in these diameters seems sufficiently large to indicate that a real difference results from use of the bite-plate.

With regard to total face height, the greater increment in the bite-plate cases may in large measure simply mean the opening up in the anterior region, as a result of a downward growth in the molar region of the maxillae, or a shifting in position of the mandible.

Let us return for a moment to the three cases wherein application of the bite-plate apparently caused depression of the lower incisors. One of several possibilities would appear accountable for the phenomenon. First, a slight tipping of the incisors may have occurred in the course of treatment, causing the somewhat shorter diameter to the chin. This possibility, however, would not seem to explain the diminution between infradentale and menton. Secondly, actual depression of the lower incisors with perhaps consequent slight resorption and lowering of the mandibular alveolar or infradentale point, even if very slight in extent and very rare, might have been the result of insertion of the bite-plate.

In one of the three cases, however, it was found that, in addition to the bite-plate, the lower anterior teeth were ligated about three months before the decrement was noted. Furthermore, seven months after removal of the ligations, when the subject was remeasured, there was an increase in the anterior height of the mandible of 3 mm., not only compensating for the preceding diminution of 1 mm., but manifesting an additional growth of 2 mm. It is not unlikely that the two other cases will likewise later show additional increment upon removal of the bite-plates or even during their use.

It occurred to me to ascertain the frequency of a depression of the lower incisors (diminution of the lower incisor to the inferior border of the mandible dimension) in cases treated orthodontically, but not with the bite-plate. Interestingly enough, 7.3 per cent of 343 patients showed a decrement of 1 to 3 mm., apparently a depression of the lower incisors to that extent. In almost one-third of the cases (32.1 per cent), moreover, no change whatever occurred —in each case, over a period of approximately one year. Closer examination of these data, however, revealed that in every case of decrement, the lower incisors had been ligated for several months preceding the second measurement. The ligations had been inserted at the time the appliance was adjusted in order to create a tipping upward of the lower molars. The reaction of an adjustment of this kind, with the simple labial appliance, would ultimately tend not only to depress the lower anterior teeth, but also to tip them forward. It should be mentioned that in all these cases, an elevation or increment occurred in the molar region of the mandible concurrently with a diminution anteriorly. The pertinent and remarkable fact is, however, that, in every single case wherein ligations were removed and additional examinations

were available (nineteen cases in all), the height from the incisal edge to the inferior border of the mandible returned to the original measurement, not infrequently exceeding the original figure. Furthermore, in a number of cases wherein a fourth measurement could be made, the additional height was found to be maintaining itself, both in the anterior and in the posterior regions. It might be mentioned in this connection that, at the time of examination, the preceding measurement was unknown to the anthropometrist.

All the evidence therefore points to the fact that although a slight depression of the incisor teeth may occasionally occur in the course of orthodontic treatment, with or without the bite-plate, it is practically in every instance merely a temporary phenomenon. Oppenheim[8] recognized this fact, stating that "the frequency of relapse that occurs in shortened front teeth is almost without exception." (P. 113.) Apparently as a result of empiric observation, Dunn[10] found similar conditions, remarking that "when forced by mechanical appliances to positions of infraocclusion they (lower incisors) will invariably return (after being released) to their typical vertical arrangement." (P. 687.) In addition, Dunn makes the following rather startling statement in the same paper: "It is a singular fact that in the development of the dental apparatus the mandibular incisors are invariably normal in their vertical arrangement. . . . They are intended as a guide or fixed point by nature, in her process of vertical development in molar and premolar region." (P. 687.)

I am not prepared to say that the lower incisors are in an absolute sense "intended as a guide or fixed point by nature." It does seem to me, however, that the evidence adduced in the present paper points to remarkable stability in the incisor region relative to growth posteriorly.

A final source of evidence strikingly substantiating the preceding with regard to the minimal effect of the bite-plate in the incisal regions is the following: Microscopic serial sections were obtained on three lower incisor teeth which had been subjected to the action of the bite-plate for a period of eleven weeks. (Fig. 3.) As is readily seen, there is no evidence of bone destruction or of cementum destruction. There is no congestion of the periodontal membrane. The bone structure is at least as dense as that which would normally be expected in a child of 15 years, the age of the subject. The roentgenogram of the section before preparation (Fig. 4) gives further evidence of an unusually dense bone structure. The cancellous structure is more closely packed than usual, and the intratrabecular spaces are unusually small.

In conclusion, I wish to make clear one point. The preceding has demonstrated the usefulness of the bite-plate in elevating the molar area of the mandible with scarcely any concurrent effect on the incisor region. This may have given the impression of a special plea for the use of the bite-plate appliance. Such was not my purpose. My primary concern was rather to examine the efficacy of the theories of bone growth as applied to the dental structures. According to these theories, bone growth should be stimulated in the direction of least resistance. The direction of least resistance was therefore created with the molar and premolar teeth relieved of occlusion, attained by means of the bite-plate. As a consequence, the bone in the molar region was actually stimulated to growth, as proved by quantitative observations. Other things being equal, any other appliance attaining the same end, namely temporarily freeing the molar regions from occlusion and thereby providing a stimulus for additional growth, would do.

With regard to the anterior teeth, the

remarkable stability of their vertical dimension was long suspected, and is now substantiated, as theoretical considerations demanded that pressure (induced by the bite-plate on the incisors) would strengthen bony structure rather than destroy it.

In short, it was my aim to point out the essential concurrence of theory with observation in the growth of bone, in the present instance the dental structures. This, I hope, will in turn give impetus to a rational rather than an empiric procedure in the practice of orthodontics.

SUMMARY

It has been shown by a review of the literature on bone growth that the contentions of one orthodontic school of thought that the bite-plate induces depression of the lower incisors and no elevation in the molar region were not valid. On the contrary, increased pressure in the incisor regions resulting from use of the bite-plate actually tends to strengthen the bony structure in this area (Jansen, Macewen, P. D. F. Murray, Oppenheim). Furthermore, with the molars free from occlusion as a result of application of the bite-plate, thereby affording the "direction of least resistance" in this region, upward growth in the mandible and downward growth in the maxillae should be and were accelerated. It was recalled that Oppenheim and others have demonstrated essentially this phenomenon when one of the antagonist molars was extracted, loss of occlusal contact consequently inducing development beyond the occlusal plane.

After consideration of the theoretical aspects of the problem, I presented metric evidence demonstrating the following main conclusions:

1. Depression of the lower incisor teeth as a result of using the bite-plate was a rare occurrence and slight in extent.

2. Depression of the lower incisor teeth in general orthodontic procedure (excluding the bite-plate) was also relatively very infrequent.

3. There was a definite tendency, practically invariable, for any depression of the incisors to return sooner or later to the preceding height and even beyond. In other words, depression, when it did occur, was merely a temporary phenomenon.

4. Appreciable elevation in the molar region of the mandible was an actuality in subjects using the bite-plate.

5. Comparison of growth in the vertical aspects of the face made between bite-plate cases and cases in which there was no orthodontic treatment whatever clearly indicated that, first, there was practically no difference in the development of the vertical height of the mandible anteriorly; and, second, growth in the molar region of the mandible was strikingly accelerated in the bite-plate cases in contrast with the cases not treated orthodontically. It follows that as regards growth anteriorly, the elevation in the molar region was considerably higher in the subjects using the bite-plate.

These facts were corroborated by comparable material adapted from English studies.

6. The stability of the vertical incisor height was further attested by the similarity in mean annual increment, in normal and abnormal occlusion.

7. A microscopic study of serial sections of three lower incisors which had been subjected to the rigors of the bite-plate for eleven weeks, as well as the roentgenographic section before preparation, clearly showed no pathosis in the teeth or the investing tissues. The latter, on the contrary, appeared strengthened.

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DENTURE BASE MATERIALS AS RELATED TO PROSTHETIC ORAL HEALTH SERVICE

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I AM aware that the subject "Denture Base Materials as Related to Prosthetic Oral Health Service" is one of extreme importance and of vital interest to the dental profession. Further, I am not ignorant of the fact that the recital of my experience with a denture base material may be interpreted as advocating the use of that material. Let me say, therefore, that in the past I have refused to discuss this subject because of insufficient personal experience with the many denture materials available to the dentist.

During the past twenty years, denture base materials have come and gone. With each new denture material, hopes have risen—and fallen. Each possessed some advantages, but not enough to outweigh its disadvantages, and always we have turned back to vulcanite with its poor color and its porosity. For me to intimate that the ultimate in denture materials has been found would be folly, for, it is admitted, organic chemistry is yet in its infancy. I do believe, however, that the cumulative efforts of the past are beginning to bear fruit. I sense a willingness on the part of the profession and the public to be weaned away from the use of vulcanite, and they are both less complaining when the substitute is found wanting.

My interest in any denture material is entirely professional and is based on several principles vital both to the profession and to the public: (1) that the material shall provide a high grade oral health service with all that this implies in comfort, esthetics, tissue compatibility, oral hygiene, permanence, reparability and expense; (2) that the dentist shall voluntarily select the materials used in his professional service on the basis of merit and that his choice shall not be influenced by high pressure salesmanship, and (3) that the fabrication of dentures by such materials may be readily taught to undergraduate students in the schools and likewise readily used by dentists in practice, such processes thus being kept

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under the supervision of the profession and not under the control of the dental laboratory industry.

The excellent work of the Research Commission of the American Dental Association at the National Bureau of Standards in Washington, together with research carried on in universities and in industrial concerns, should soon bring to a close the present speculative era in denture base materials and lead to scientific standardization of specifications for those products required by the dentist in rendering an oral health service to the public.

ACRYLIC RESINS

Acrylic resins have recently been adapted to dental use. Much of the following technical information on this subject is taken from an article by D. S. Frederick.[1]

In 1843, Redtenbacher prepared a new acid, acrylic acid, by oxidation of acrolein. Eighty-four years later, in 1927, Bauer, working with Otto Röhm, of Darmstadt, Germany, developed a synthesis making possible production of small quantities of methyl ester of acrylic acid. Products of polymerization of acrylic acid and its derivatives are known as acrylic resins. Polymerization is the chemical process by which two or more molecules of the same kind unite to form another compound having the same elements in the same proportions, but a higher molecular weight and different physical properties. One of the monomeric compounds, methacrylic acid, polymerizes readily to form solids, and this group has many industrial applications.

Monomeric esters are converted into resins by polymerization, a process which is hastened by light, heat and oxygen, but inhibited by hydroquinone. Polymeric esters are characterized by colorless transparency, stability against ageing, thermoplasticity and resistance to many reagents. They range in consistency from soft, sticky, semiliquid to hard, tough solids. Their resistance to weather has been shown by three years' exposure to weathering and sunlight without discoloration, loss of gloss or failure of the harder films. They are stable in light, heat and oxidizing agents. The monomeric esters polymerize to solids in casting operations, while the polymeric esters are thermoplastic solids, which require hydraulic or injection molding.

The industrial use of acrylic resins is exemplified in the following items: windows, windshields for autos and airplanes, spectacle lenses, goggles, auto instrument dials, fountain pens, buttons, handles, knobs, electric fixtures, leather protectives and musical instruments, and new items are appearing on the market with such rapidity that its use appears almost limitless. The properties of Plexiglas, an acrylic resin, are given in the accompanying table.

PROPERTIES OF AN ACRYLIC PLASTIC (PLEXIGLAS)

Clarity	Light transmission 92-95%
	Scattering effect 0.5-1.5%
Refractive index	1.49
Specific gravity	1.18
Hardness, Mohs	2-3
Vickers	17-20
Brinell	18-20 (500Kg.-10 mm.)
Tensile strength @ 30°C.	7000-9000 lb. per sq. in.
Elongation at failure @ 30° C., 5%	
Flexural strength @ 30° C.	15000-17000 lb. per sq. in.
Impact resistance	0.3-9.5 ft. lb. (A.S.T.M. Charpy notched bar)
Modulus of elasticity @ 30° C.	6×10^5 lb./sq. in.
Coefficient of expansion @ 30° C.	0.00008/°C.
Water absorption by weight, complete immersion at 30° C.	
24 hr.	0.3%
48 hr.	0.5%
500 hr.	1.2% equilibrium
Dielectric current	3.0-3.6
Volume resistance	10^{13} ohms./cm^3.

Until recently, acrylic resins were molded by heat and relatively high pres-

1. FREDERICK, D. S.: Acrylic Resins Find Industrial Applications. *J. Chem. & Metallurg. Eng.*, 44: September 1937.

sure. Such pressure made their use impracticable in the field of dentistry, since specially designed and expensive equipment was needed to process the resins. Reference to the European literature indicates that such difficulties were perhaps partially overcome, because dentures of acrylic resin have been made there during the past six years. More than two years ago, an American dental manufacturer discovered a process whereby acrylic resin could be reduced to a plastic state as required in denture prosthesis, so that, without extra laboratory equipment, it could be readily used as a denture base material.

In June 1938, a patent was granted by the United States Patent Office to Daniel E. Strain, assignor, by mesne assignments to E. I. du Pont de Nemours and Company of Wilmington, Del. This patent presented twelve claims on the molding of organic compounds, particularly those comprising intimate admixtures of polymeric monomethacrylic acid esters and monomeric methacrylic acid esters.

From this patent, a general idea of both the materials and the methods of molding them for industrial uses can be obtained. It is assumed that such methods with modifications are applicable to the dental use of such materials.

As previously mentioned, polymeric monomethacrylic acid esters, being thermoplastic, were molded under pressure and temperatures which were appreciably in excess of the softening temperature of the molded article. This method necessitated the cooling of the mold before the molded article could be ejected; otherwise, warpage resulted. Obviously, such a high temperature process was both time-consuming and painstaking, which tended to curtail industrial use of these resins. Industrial research, therefore, was directed toward a method whereby these esters could be molded at temperatures below the softening temperature of the molded article. This is accomplished as shown in the patent by intimately admixing a polymeric monomethacrylic acid ester, with 10% to 100%, by weight thereof, of a monomeric monomethacrylic or polymethacrylic acid ester, the resulting composition being readily molded at relatively low temperatures, between 70° and 200° C., and at pressures from 2,000 to 3,000 pounds per square inch, during a molding cycle of from one to ten minutes.

This simplified molding is made possible by the presence of two components: a monomer and a polymer. The monomer (soft) component may be considered as a fugitive active plasticizer for the polymer (hard) component. That is, the monomer component is a solvent for the polymer component and permits the composition to be more readily molded at lower temperatures and/or pressure, as a permanent plasticizer would, and yet, after the molding operation, the monomer component has been transformed into a polymer and no longer functions as a plasticizer. The function of the monomer is not entirely that of a fugitive plasticizer, since, under certain conditions, it adds strength to the molded article. In this respect, the thermoplastic process involved in the use of acrylic resins in dentistry differs markedly from the thermoplastic processing of vinyl resins. Whereas vinyl resins require critical temperatures equal to their softening points and high pressures capable of deforming the solid blank during the molding operation, acrylic resins are soft, may be packed into the mold as is rubber, molded with 2,000 to 3,000 pounds pressure and polymerized, if desired, at noncritical temperatures below 212° F. Further, acrylic resins, properly prepared, are relatively strain-free, a necessary characteristic of a denture base material. Vinyl resin dentures tend to unmold (warp) and frequently fracture under masticatory stresses, whereas acrylic resin dentures, as observed during the past two years, have not become unserviceable

because of warpage, nor have they broken, except when intentionally made too thin in order to test their strength under actual mouth conditions.

During the past year, acrylic resins for dental use have been tested at the National Bureau of Standards and at the University of Michigan. Some of these data indicate that such changes as occur during molding and during actual service of the dentures are similar in some respects to those of vulcanite and have little significance in relation to the oral health service provided by acrylic resin denture base materials.

RECORDS OF TESTING OF ACRYLIC RESINS

The decomposition of denture base materials common to many of the substitutes for rubber has not been experienced with acrylic resin after dentures have been worn for two years. I am aware, however, that two years of testing in service is not long enough to insure stability of the material during the average life of a denture, which is not less than five years. From the biologic viewpoint, a 5-year-old denture has probably long since passed the peak of its efficiency and should be rehabilitated to meet the changing conditions of the patient's mouth.

From the foregoing study of acrylic resins as now available to dentistry, we may assume that this material, in its present form, or in some modified form, stands a fair chance of becoming a widely used denture base material. Acrylic resins promise an almost limitless number of combinations, permitting the use of a wide variety of fillers and pigments, together with variable molding temperatures, pressures and cycles, which have not, as yet, been tried in dentistry.

Because of the present desirable qualities and the potential future development of acrylic resin, its use in the field of dental prosthesis will be briefly discussed.

For many years, we have sought a denture base material that would displace rubber. Experience has shown that such a substitute for rubber should be (1) readily fabricated by the dentist, (2) strong, (3) permanent in form, (4) natural in appearance and permanent in color, (5) impervious to oral secretions, (6) inert, (7) favorable to oral health and (8) universally useful for all kinds of appliances required in denture prosthesis.

In addition to requiring these qualities, prosthetic oral health service affords opportunity for the use of clear, transparent denture base materials in the making of immediate dentures, obturators, interdental splints and complete and partial dentures. In the past, a good appearance has been the chief objective in the development of new denture base materials. In the future, oral health will assume an increasingly important place. Transparency in a denture base material offers distinct advantages since it affords an unobstructed view of the denture-supporting tissues while the denture is being worn by the patient. Thus, the affected areas are readily and accurately located and relieved. Acrylic resin provides both desirable features: a pinkness of pleasing and natural appearance and a transparency resembling that of clear glass. The two types may be used singly or in combination as desired, since they are basically the same material. In the field of complete dentures, all pink may be used, or, as some prefer, denture bases of transparent resin may first be prepared and the teeth be attached later by the use of the pink resin.

Partial dentures likewise may be made with the desired color combination. In regard to the strength of partial dentures, the resins have been found applicable to such appliances as are usually made of vulcanite, including lingual and palatal bar dentures. For lingual or palatal bars, it is advisable to make such parts slightly thicker and to reinforce these attenuated connectors with a strengthener of metal. Partial dentures, less than 2 mm. thick,

have been successfully worn without breakage.

Transparent acrylic resin has opened a new field in immediate dentures, obturators and interdental splints. Immediate dentures may be made of transparent resin, except the exposed surface of the denture. Thus, the operator is permitted to view the underlying tissues after the teeth have been extracted. Areas interfering with the seating of the denture can be observed through the clear base, and accurately located by marking the denture with an indelible pencil; after which the tissue can be further treated surgically or the denture may be relieved.

The acrylic resins promise to revolutionize the making of interdental splints. With the transparent resin, it is possible to construct overlay splints such as are used temporarily in increasing the vertical jaw relation for diagnostic purposes. These splints may be made with great accuracy so that they will snap into place on the natural teeth and effectively resist displacement during function. Further, the transparency of this material makes the splint inconspicuous, even though it covers the incisal edges of the anterior teeth.

Finally, cleft palate and similar afflictions can be successfully treated with appliances made of acrylic resins. The nature of the resin permits additions and repairs as readily as with rubber. It is therefore possible to make a transparent palatal portion for the cleft palate, after which the bulb portion may be muscle-trimmed to the nasopharyngeal region. During the muscular adaptation of the bulb, the operator may observe, through the transparent base, the muscular activity of the tissues surrounding the cleft. In this manner, the desired freedom may be determined and provided before the obturator is completed. Subsequent adjustments, if necessary, may be accurately made after observation of the affected tissue through the transparent base.

Looking into the future, I see the need for the development of a suitable investment material before acrylic resins can become fully and universally applicable to the exacting requirements of prosthetic oral health service. During dental molding, acrylic resins must at present be invested in plaster of Paris or artificial stone, as commonly used with rubber. Unless protected by tinfoil, acrylic resins will blanch because of the moisture in such investments. To make tinfoiling unnecessary, several investment materials have been tried, of which only one is reasonably satisfactory for use with acrylic resins. We look to the near future when, perhaps, investment materials satisfactory for use with acrylic resins will be available. Such materials must be strong, quick-setting, anhydrous, with control of expansion within desired ranges, easily manipulated and without deleterious effect on the resin. When such investments have been developed for the specific dental requirements of acrylic resins, we may expect the rapid application of them to prosthetic oral health service.

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CLINICAL MEDICINE IN RELATION TO THE DENTAL CURRICULUM AND DENTAL INTERNSHIP

By JOHN A. KOLMER,* M.D., Philadelphia, Pa.

THE importance of including instruction in the principles of clinical medicine in dental education is now so widely recognized that the great majority of dental schools have provided for such teaching in their curricula.

As stated by Gies in 1926 in his report on a survey undertaken by the Carnegie Foundation for the Advancement of Teaching, while the practice of dentistry cannot be made an accredited specialty of medicine, it should be developed into "the equivalent of an oral specialty of the practice of medicine"; and he adds:

> In this view of an enlarged dentistry, its practitioners would be trained to give the service not only of dental surgeons and dental engineers as at present, but of oral sanitarians and oral physicians as well. Instead of examining only the teeth and mouth of a patient, as is now usually the case in a restricted view of their responsibility, they would also suitably enquire into and keep careful records of the state of the patient's health, particularly as it affects or is modified by conditions of the teeth and mouth. Dentists would plan their procedures to meet not only the local indications, but also the possible requirements of extra-oral relationships; would also recognize and note the significance of outstanding symptoms of systemic disease, and warn or advise the patient accordingly, or explain his need for a physician's attention; and could effectively discuss, with a physician, the oral conditions in their relation to the patient's general welfare. Prevention of disease at all ages would become an inherent and predominant motive.

This requires not only adequate instruction in the principles of medicine by lectures, but some clinical instruction as well, and, in addition, tends to enable the dental practitioner to read medical literature more intelligently, to participate more actively in public health work and to better appreciate and cooperate in bedside consultations, hospital procedures and routine activities.

However, there are still marked differences of opinion regarding the objectives to be attained and the amount of time to be devoted to general medicine in the teaching of dentistry. In some schools, the subject is apparently confined to what is listed in their catalogs as "dental medicine," or physical diagnosis. A few apparently do not include medicine at all; while, in some, it appears that too much time may be devoted to the subject when it is remembered that the adequate teaching of modern dentistry alone demands a heavy four-year curriculum.

As compared with the curricula of medical schools, however, including as they do even more instruction in the basic subjects of anatomy, chemistry, physiology, pharmacology, pathology, bacteriology and public hygiene, as well as medicine, surgery and obstetrics and the specialized subjects of dermatology, pediatrics, gynecology, ophthalmology, neurology, otolaryngology, orthopedics, radiology, etc., it is apparent that, with a little revision, the curricula of dental schools can readily provide for the instruction in general medicine so desir-

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able for rounding out the education of the modern dentist. The question is how much time should be devoted to the subject and how should this time be divided, since medicine alone is a very large subject and requires the finest of judgment in reaching a decision upon the phases to be taught in the modern education of the already hard-worked student of dentistry?

In the accompanying table, I have summarized the number of hours devoted to instruction in medicine in thirty schools of dentistry as a cross-section of the subject at the present time. In a few instances, I have included those schools teaching "physical diagnosis" only, since I surmise that this may include some aspects of general medicine; but I have not included "dental medicine," since I did not know exactly what this embraced and assumed that it certainly did not include internal medicine as this is understood at the present time. It will be noted that anywhere from eleven to 635 hours are devoted to the subject according to the latest catalogs of the schools listed. Excluding the School of Dentistry of Meharry, where it seems to me that a total of 635 hours is too much, I find that the average for the remaining twenty-nine schools is about fifty hours. Some of these

HOURS DEVOTED TO MEDICINE IN SCHOOLS OF DENTISTRY

School	Hours per Session			Total Hours*
	Sophomore	Junior	Senior	
Atlanta-Southern Dental College		33		33
Baylor University		16		16
Columbia University			90	90
Creighton University			32**	32
University of Southern California		16		16
University of Detroit			64	64
Howard University		44**		44
University of Illinois		32	32	64
Kansas City-Western Dental College		32		32
University of Louisville		48	32	80
Loyola University			16	16
Marquette University		34	17	51
University of Maryland		32	32	64
Meharry Dental College	105	300	230	635
University of Michigan			16	16
University of Minnesota		33		33
New York University		22		22
North Pacific College of Oregon		33*	17	50
Northwestern University			11	11
University of Pennsylvania	32	64	10	106
Ohio State University	64			64
University of Pittsburgh		32	32	64
St. Louis University		32		32
University of Tennessee			88	88
Temple University		24	16	40
Texas Dental College		33		33
University of Toronto			34	34
Tufts College Dental School	16	16	84	116
Washington University		64	32	96
Western Reserve University			48	48

*Includes lectures in medicine, physical diagnosis, clinics and conferences.
**Listed as physical diagnosis.

schools give lectures only on the principles of medicine, while others teach the subject by lectures supplemented by conferences and clinical instruction. Nor have I included the School of Dentistry of the University of Rochester because I am unable to determine just how many hours are devoted to medicine. Apparently, sixty-four hours are assigned to lectures in the junior year, with such adequate provision for clinical clerkships in medicine and pediatrics in the wards and clinics of the hospital during the senior year as to give the impression that this particular school provides for more instruction in these subjects than any other school with which I am familiar.

Incidentally, the report in 1935 of the Curriculum Survey Committee of the American Association of Dental Schools recommended thirty-two hours of lectures devoted to the principles of medicine, and while this appears adequate as far as lectures are concerned, it is apparent that lectures alone are insufficient, since supplementary clinical instruction is absolutely essential.

It will be noted that four of the thirty schools listed in the accompanying table give instruction in medicine in the sophomore year, and that, indeed, one (Ohio State University) confines the instruction in medicine to this year. It appears to me that it more properly belongs to the junior and senior years in a dental school, although I am strongly in favor of clinics for the freshmen and sophomore classes of medical schools in order to correlate clinical medicine with the basic subjects of anatomy, physiology, chemistry, bacteriology and pathology. Incidentally, to include instruction in medicine in dental schools requires a broadening of instruction in anatomy, physiology (including physiologic chemistry), bacteriology and pathology (including clinical pathology), of such fundamental importance in relation to internal medicine, instead of confining these subjects largely to such phases as more intimately concern the oral cavity.

My experience at Temple University School of Dentistry leads me to think that two lectures a week during one semester of the junior year totaling a minimum of twenty-four and a maximum of thirty-two hours are probably sufficient for teaching the principles of medicine, since no attempt should be made to approach the instruction required in the education of physicians and a reasonable balance should be struck in order not to encroach too much upon the primary object of training young men and women for the practice of dentistry.

These lectures, however, require extraordinary care in their preparation and scope and, as far as possible, should be illustrated with lantern slides in order to adequately cover the subject in relation to the general education of the dentist, with particular emphasis upon those systemic diseases, including diseases of the skin, which may have oral manifestations and those which may be of dental origin. Under the former, I include diseases of the gastro-intestinal tract, the kidneys, blood and blood-forming organs and the endocrine glands, the diseases due to allergy, the avitaminoses, many of the acute and chronic infectious diseases with special reference to syphilis and many due to chemical intoxications; under the latter, those due to focal infection of dental origin with special reference to the diseases of the joints and related structures, the eye, skin, etc. In addition, proper attention is required in relation to the diseases of the heart and blood vessels, with adequate instruction on the diseases of the respiratory tract, including the nose, accessory sinuses, throat and larynx, as well as those of the nervous system, since the purpose of the course should be to give a broad general instruction in medicine to as nearly as possible approach the ideal of equipping as physicians in a broad and general

sense young men and women who are specializing in dentistry.

During the senior year, I give one clinic a week during one semester at the hospital, totaling about sixteen hours and permitting the presentation and discussion of from twenty-four to thirty cases devoted exclusively to the clinical aspects and principles of treatment. During the sixteen hours, small groups of the class are assigned to Dr. Hugo Roesler for instruction on the heart, with special reference to physical diagnosis and the technic of blood pressure determinations. A special effort is made to select cases of systemic disease with oral manifestations and those in etiologic relationship to dental conditions. A special effort is also made against duplication of cases in order to present as many different diseases as possible, but to include some without special dental significance, since the purpose of the course is not confined to teaching "dental medicine," but to be as broad as possible in regard to "internal medicine" in the time provided by the curriculum. It is admitted that one clinic a week throughout the year is highly desirable, but the solution of the question of instruction in medicine in the dental course is in a state of evolution with the hope of ultimately reaching the best possible balance, with proper precautions against overemphasis.

I am convinced that it is highly desirable for each dental school to have a medical clinic with laboratory facilities under the direction of a skilled and experienced salaried physician, to which patients can be referred from the dental service when the general health is impaired or there are evidences of systemic disease Here, small sections of the senior class in rotation could obtain clinical experience, as well as the absolutely essential instruction on the taking and recording of brief but adequate medical histories, learning as well more of physical diagnosis, with special reference to the heart.

After all, this would most nearly approach the conditions of actual dental practice, and it appears essential in the teaching of medicine as well as providing opportunities for senior dental students to conduct such simple laboratory procedures as blood and urine examinations, bacteriologic examinations of smears, cultures, etc. This is possible with all dental schools, including those without hospital affiliations, and more nearly fulfils the obligation of giving all dental patients the kind of broad health service that is demanded of modern dentistry.

Furthermore, if it is right and proper to educate dentists in the general aspects of medicine with special reference to the oral cavity, it should be done not by lectures only, but also by example, with an effort to duplicate the conditions of actual dental practice as nearly as possible. One of the best means of doing this is a medical clinic or dispensary under expert supervision where senior dental students can obtain the best possible clinical experience and sufficient training in history taking and physical diagnosis. In some schools, a "diagnostic clinic" is maintained for the preliminary diagnosis of dental conditions and the proper orientation of the services required. Under such conditions, a medical clinic under a physician, and especially one trained in both medicine and dentistry, could be included with great advantage to both patients and students.

In conclusion, I wish to make an earnest plea for more opportunities in general medicine for those taking dental internships in hospitals following graduation. It is my impression that the majority are confined to dental clinics, which, of course, afford a very useful opportunity for recent graduates to acquire experience under expert guidance. But it seems to me that every dental intern should have the opportunity of making the rounds of the wards in medicine and surgery as well, at least once or twice a week, with the

physicians and surgeons on ward services. This would enable the young dentist not only to acquire more practical experience in general medicine, but also to be very helpful to the physician or surgeon in cases requiring dental advice or service, since, in most cases, the latter is woefully lacking in practical knowledge of dental conditions.

Furthermore, such a procedure would inevitably redound to better medical and surgical practice as well as demonstrate and teach by actual example (the best teacher of all) the great value of bringing the medical and dental professions into closer contact and consultation for the welfare of the patient. At Temple University Hospital, three dental interns are now appointed for a year's service, serving in rotation in the wards to carry out these very important functions and to give patients such dental service as may be required at the time.

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FURTHER EXPERIMENTS IN ORAL GALVANISM

By M. C. Reinhard, M.A.; H. A. Solomon, D.D.S., and H. L. Goltz, B.S., Buffalo, N. Y.

IT has been our contention, [1, 2, 3, 4] that, although the essentials of an electric battery are present in mouths containing dissimilar metals employed in restorations, no electric current is flowing normally. We do not mean to imply that there are not certain isolated cases in which such a phenomenon may occur, but that, in the vast majority of mouths having dissimilar metallic dental restorations, no current is flowing.

That the essentials of a galvanic cell are present where there are dissimilar dental alloys was shown in a recent publication,[4] in which a voltage chart was included. The values listed in this chart were obtained by measurements, with human saliva as the electrolytic solution; whereas the values in the electromotive series of elements usually referred to in this type of work represent the differences of potential between various metals and a single electrolyte in solution. Because saliva is a colloidal solution containing several inorganic salts in addition to its organic contents, we would expect marked differences between the values obtained with it as the electrolytic solution of the cell, and with a single inorganic electrolyte. We would like to emphasize, however, that the voltage chart as published was based on measurements with the saliva of one individual at one time. There were wide variations in the voltage differences determined in saliva obtained from different individuals as well as from one individual at different times. A voltage chart of this type offers no indication as to the possible current flow and as to the relative merits of the various metallic alloys for dental restorations.

In view of the potential differences obtained experimentally, the question may well be raised: On what do we base our contention that no current is normally flowing? The present paper concerns itself with some experiments performed in order to further study this question. In a previous paper,[3] we theorized as to the various possible pro-

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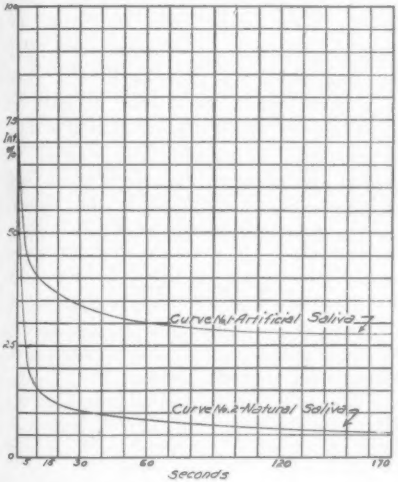
tective mechanisms which could exist in a mouth and which would act to reduce or retard current flow, and came to the conclusion that three possible forces could act as a protectant in the reduction of current flow: polarization, cataphoresis and chemical change on the surface of the metal. The experiments reported here, which have to do with polarization and cataphoresis, were carried out in order to determine whether polarization or deposition of organic material (cataphoresis), or both, played a rôle in the reduction of current flow between dissimilar dental metals in the mouth.



Current flow between two different dental alloys.

EXPERIMENT 1

The purpose of the first experiment was to study the effect of polarization on the flow of current between dental metals. The flow of current was determined between two dental alloys, A and B, used as electrodes. These electrodes were partially immersed in a solution simulating natural saliva in its inorganic salt content, but containing no organic or colloidal material. The electric circuit and current measuring device used were the same as described in a previous paper.[2]

The results of these measurements of current flow, read over a period of several minutes, are shown graphically in curve 1 in the accompanying chart. For purposes of comparison, the current values are relative only. The absolute values were published previously. It is evident that there is a 72 per cent drop of current flow within the first few seconds following the closing of the circuit. This drop is due to formation of a gaseous film of hydrogen on the metallic surface of one of the electrodes, insulating it.

When the circuit is interrupted by opening the switch, this gaseous film disappears, so that, on closing the switch a second time, the current values measured were the same as when the switch was first closed. We can conclude from this experiment that polarization is responsible for the marked reduction in current flow indicated in the graph.

EXPERIMENT 2

The second experiment was made to determine the effect of natural saliva as an electrolyte on the current flow between two dissimilar dental alloys. In Experiment 1, it was shown that when an inorganic electrolyte was used, polarization did occur. In Experiment 2, the inorganic electrolyte, artificial saliva, was replaced by human saliva, in order to determine whether the presence of organic material would also play a part in the reduction of current flow. The experimental set-up was the same as in Experiment 1, and the results of the measurements are shown in curve 2. It is plainly evident that the drop in current value, 95 per cent, is even more marked under these conditions than in Experiment 1. Measurements made with natural saliva, after the circuit was interrupted and closed, showed that the current values did not return to the values obtained before the interruption;

which was contrary to the findings in Experiment 1.

It was to be expected that polarization would occur with human saliva, if it did with artificial saliva, as solutions of inorganic electrolytes are present. Because the drop in current value was greater than that obtained in Experiment 1, and because the current failed to return to the initial value after interruption, we conclude that an agency other than polarization was acting to further diminish the current flow beyond that due to polarization. This agency may be cataphoresis or the deposition of an insulating film on the surface of the alloy, which, unlike the film of hydrogen in the case of polarization, does not disappear when the circuit is interrupted.

EXPERIMENT 3

Experiment 3 was undertaken to investigate the problematical film deposit. If, after gentle mechanical abrasion of the electrodes subsequent to the interruption of the current, readings should be obtained which would check with the original readings as shown in curve 2, we could be reasonably certain that some substance had been removed which had been acting to prevent current flow.

After the electrodes had been in a closed circuit for several minutes, as in Experiment 2, the current was interrupted by means of a switch, the electrodes were removed, rubbed with a linen towel and replaced in the electrolyte (saliva and artificial saliva) and another set of readings were made. With this procedure, the current values obtained with both electrolytes agreed with the original readings before interruption, in both magnitude and rate of decrease, indicating that the film deposited as a result of cataphoresis had been removed in the case of saliva, but there being no film to remove in the case of artificial saliva, no change was noted.

Since this drop in current occurred in these *in vitro* experiments, it is reasonable to conclude that a comparable drop would occur *in vivo*. In other words, there would be a marked decrease in current immediately after a restoration was made in a mouth in which at least one restoration had previously been made. On the basis of these experiments, it is concluded that the diminution of current flow is due in part to polarization and in part to deposition of an insulating film. Further diminution in current flow could be caused by chemical changes occurring on the exposed surfaces of the metals used in the restorations.

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DENTAL ROENTGENOGRAPHIC EVIDENCE OF INFECTION OF THE MAXILLARY SINUS

By Louie T. Austin, D.D.S., and Bert E. Hempstead, M.D., Rochester, Minn.

A PART of each maxillary sinus is usually evident on each side of the midline along the upper border of the roentgenograms of the molar and bicuspid teeth. Occasionally, interest is aroused by a dissimilarity in density of color, size or outline of the two sinuses, or by part of the history given by the patient.

Since only a limited portion of the sinuses is visible, and this is partially obscured by the superimposition of other structures, a study of this area of the roentgenogram is apt to be discouraging. However, a review of the dental roentgenogram and comparison with roentgenograms of the skull in a series of cases in which a definite diagnosis of suppurating maxillary sinusitis was made was found to be of interest.

Normally, the two portions of the maxillary sinus appearing on each side of the midline in the dental roentgenograms are approximately of the same density, size and outline. The bony wall of the cavity can usually be noted as continuous and it is a little thicker or heavier than the cortical bone in the region of the tuberosity of the maxilla. Most frequently, the anterior limits of the sinus will reach the space between the cuspid and the first bicuspid tooth, although it may extend mesially and almost reach the midline, or it may extend distally to the region of the molar teeth, when the sinus will appear very small in the roentgenograms or may be entirely absent. The distal wall of the sinus is limited by the thin bony wall of the tuberosity. The lower border is irregular, and, in many instances, the cavity appears definitely septate buccolingually.

The lowest portion of the sinus usually is situated in the region of the first molar. More often than not, the level of the floor of the maxillary sinus of an adult will be lower than the level of the floor of the nose.

The variation in size of the maxillary sinus and the anatomic variation in the maxillae at times results in a very intimate relationship between the sinus and the molar and bicuspid teeth.

When the maxillary sinus appears small in the dental roentgenograms, it will be uniformly smaller in the roentgenograms of the head. (Fig. 1.)

In some cases, the hard palate will be in evidence and the lower border of the maxillary sinus will not be visible. In such cases, the hard palate will indicate the relative levels of the two sinuses. In a radical operation on the sinus in such cases, the rhinologist is not apt to disturb the teeth lying below it, and drainage will be found more satisfactory, since the floor of the sinus is above the floor of the nose. When the sinus is small or not in evidence and the hard palate appears as thick and dense as or more compact than normal, it will be found that the rhinologist will also report

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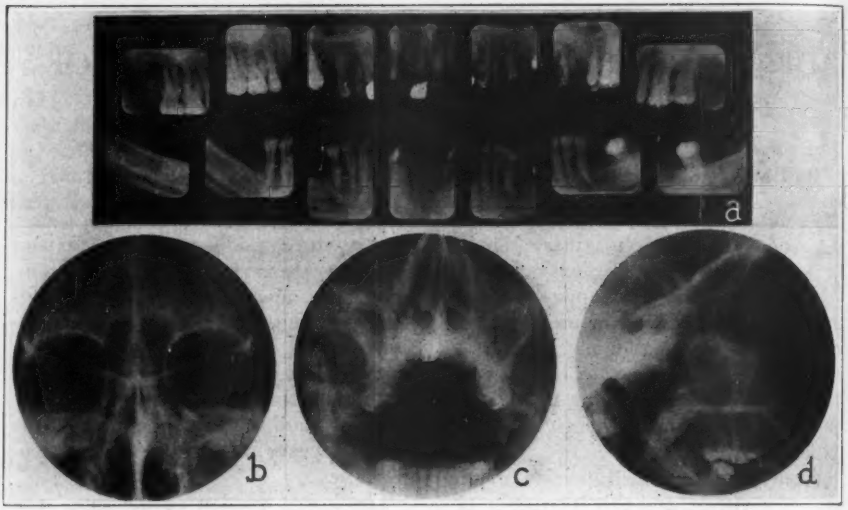

Fig. 1.—a: Dental roentgenogram in case in which only small portion of maxillary sinuses appear, indicating that cavities will be found small. There is not a sufficient shadow of the sinuses to warrant an opinion as to the condition of the sinus. b: Roentgenogram of frontal sinuses of same patient. c: Extra-oral roentgenogram of maxillary sinuses which were reported as both sides cloudy with thickened membranes. One may note the small size of the sinuses. d: Lateral roentgenogram of patient.

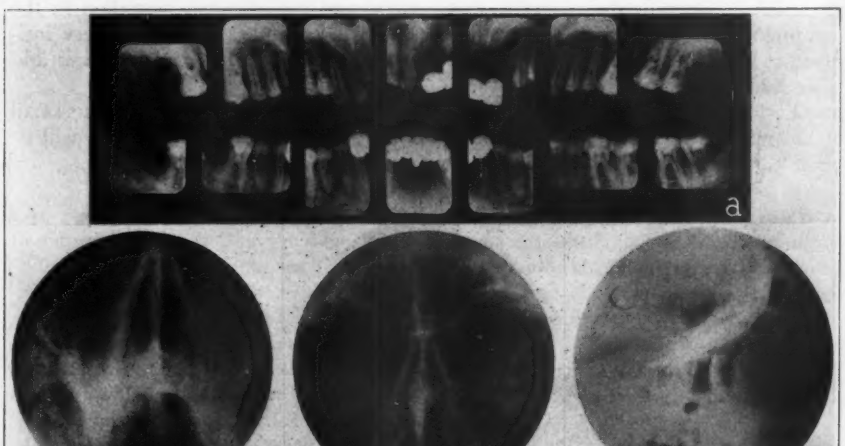

Fig. 2.—a: Dental roentgenogram giving no evidence of maxillary sinuses. The hard palate is thick and dense. When this is true, the lateral wall of the nose will be thick and dense. b: Roentgenogram of the maxillary sinuses indicating chronic thickening of both sinuses with osteitis of antral wall. c: Roentgenogram of frontal sinuses of same patient. d: Lateral roentgenogram of head, showing dense hard palate.

the lateral wall of the sinus as thick and difficult to penetrate. (Fig. 2.)

When the sinus appears large and the hard palate is not in evidence or is barely perceptible or it appears along the upper border of the roentgenograms of the molar and bicuspid teeth, the teeth will appear to protrude into it and will be apt to perforate the cavity during extraction. In such cases, the rhinologist will not obtain such good drainage of the sinus either through the natural opening or by surgical procedure, since it acts as a reservoir, and injury of the patient's dental roentgenograms and in roentgenograms of the skull. (Fig. 4.)

Although the shadow of the maxillary sinus appears cloudy, the dentist should not tell the patient that he has an infected sinus on the basis of this observation. The roentgenogram is only an aid in diagnosis and other factors are also to be considered, particularly the presence of drainage and discomfort on the side of the affected sinus.

It is possible that the patient had an infection in the sinus at some previous time, and since the inflammatory process

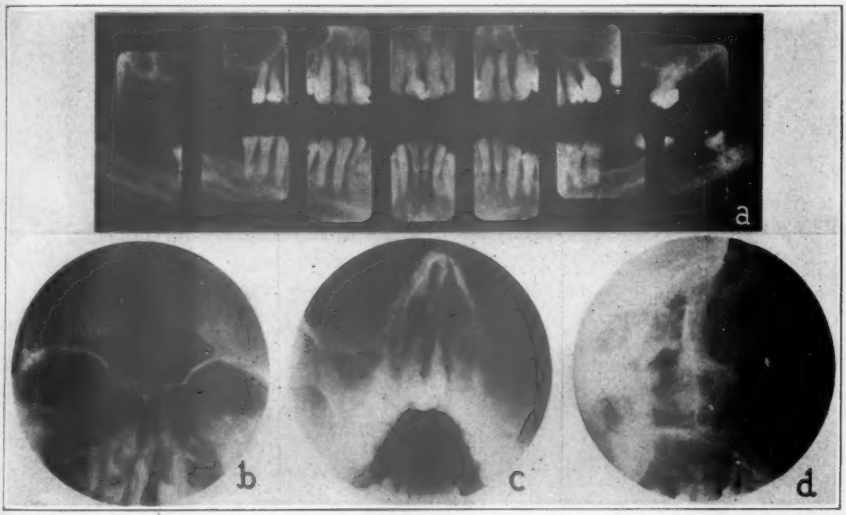

Fig. 3.—a: Dental roentgenogram showing large sinuses with no evidence of hard palate. The level of the hard palate is much higher than the floor of the sinuses. There is a pulpless molar with some rarefaction at its root ends on the right side. The right antrum appears more cloudy than the left. A septum appears in the left antrum, indicating the possibility of an accessory sinus on that side. b: Roentgenogram of frontal sinus of same patient. c: Thickened membrane of both sinuses with cyst on floor of right maxillary sinus. The patient did not respond well to treatment of the antrum until the molar tooth was removed. d: Lateral roentgenogram of head showing clearly difference in levels of maxillary sinuses and hard palate or floor of nasal cavity.

teeth is apt to occur during operations to secure drainage. (Fig. 3.)

In the clinical examination of a mouth, a persistent fistula in the alveolar process which communicates with the sinus is evidence that the cavity is infected. In such cases, it will appear cloudy in the has a tendency to thicken the membranous lining of the cavity or to cause some change in the periosteum, it may persist in appearing cloudy long after the primary infectious process has subsided.

Mustian[1] said that in his study of 100 human maxillary sinuses, there was no

landmark to aid in determining the size or form of the maxillary sinuses before they were exposed. We likewise have observed nothing in the clinical examination of a patient which would indicate the size of the maxillary sinus. A large percentage of sinuses appear to be related to the teeth in such a manner that perforation is apt to occur in the course of extraction.

Many perforations of the sinus occur in the course of removal of the molar and bicuspid teeth. In the large percentage of cases, these perforations are not recognized by the operator. They close spontaneously, and there is no evidence of the perforation in the dental roentgenogram after healing. (Fig. 5.) If a large section of the floor of the sinus is removed with the tooth, it is more likely to be noticed by both patient and operator, and the opening may become epithelized and be persistent, particularly if dressings are used and much treatment is carried on through the opening. The condition is evidenced by a break in the continuity of the shadow of the floor of the sinus. Closure of the opening by soft tissue is accomplished by a plastic operation, or by curettement if the opening is not too large. The bony wall of the sinus is not replaced, however, as is shown by the dental roentgenogram. This may result occasionally in the attempted removal of a fractured root of a molar or a bicuspid tooth. When the root has been forced into the cavity of the maxillary sinus, its removal most often requires enlargement of the opening into the sinus. The enlargement of the opening into the sinus will be indicated in the dental roentgenogram.

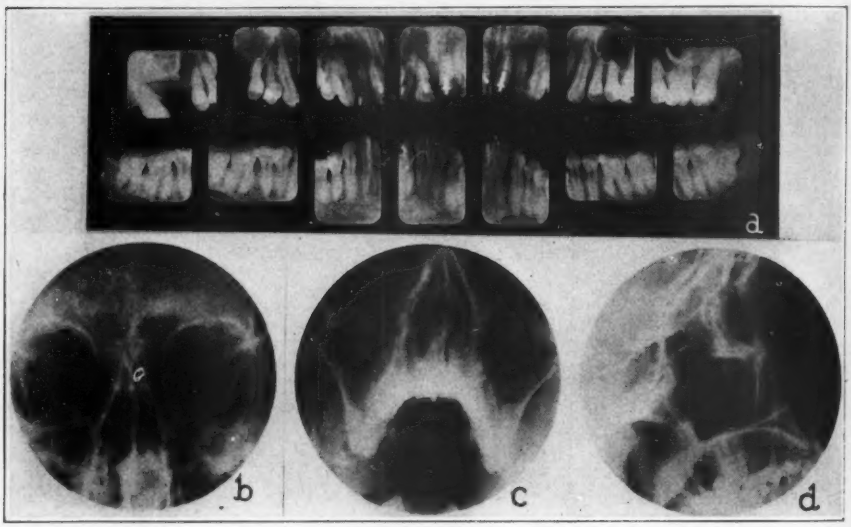

Fig. 4.—a: Dental roentgenogram showing break in floor of left maxillary sinus. The left sinus is cloudy in comparison with the right. The relationship of the teeth and the maxillary sinuses is such that perforation on extraction of the upper molar and bicuspid teeth is probable. b: Roentgenogram of frontal sinuses indicating marginal sclerosis with thickened membrane. c: Roentgenogram of maxillary sinuses. d: Lateral roentgenogram of head.

Dental infection is often related to infection of the maxillary sinus. Hempstead[2] has reported a series of 385 cases of chronic suppurative infection of the maxillary sinus, in 22.5 per cent of

which there was a definite history that the condition was due to the presence of infected teeth or their extraction, and there was a persistent fistula through the alveolar process in sixty-three cases.

A sinus that is infected from a dental condition, as evidenced by the foul odor, is spoken of as a "tooth antrum." The dental roentgenogram will show an increase in density of the sinus on the affected side. The roentgenogram of the skull will show that no other accessory sinuses are involved. This may be used as a means of comparison. (Fig. 6.) In an etiologic factor in infection of the sinus. (Figs. 6 and 7.)

The roentgenologist's report of a cyst in the maxillary sinus or on the floor of the maxillary sinus may be correct, but the cyst may be secondary to an infected root of a tooth or secondary to a dentigerous cyst that has perforated the floor of the sinus. The usual treatment of or surgical operations on the sinus will not be adequate and will not produce a satisfactory result in these instances. (Fig. 8.)

A minimum of fourteen roentgenograms is considered essential in dental

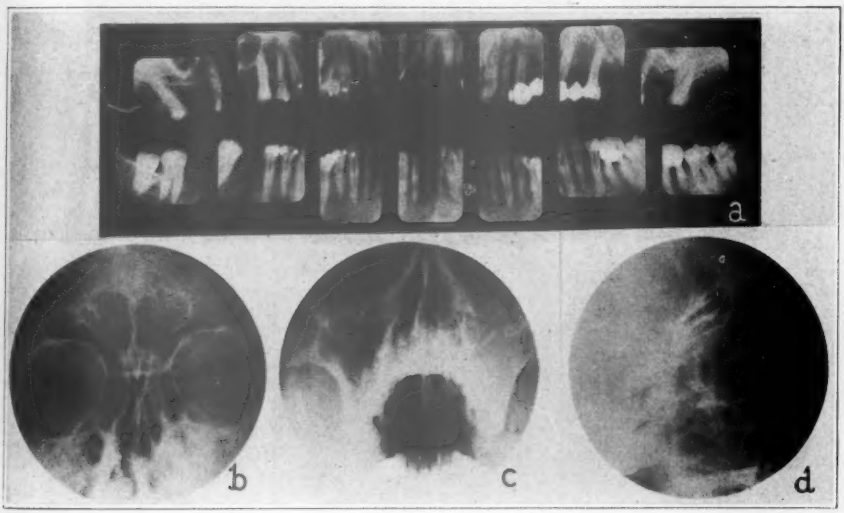

Fig. 5.—a: Dental roentgenogram showing cloudy right maxillary sinus as compared with left. There is a small break in the floor of the right sinus. The patient gave a history of perforation of the maxillary sinus at the time of recent extraction of an infected tooth, with infection of the antrum following extraction. The opening was not persistent. This is a good example of a "tooth antrum." b: Roentgenogram of frontal sinuses showing that they are not involved. c: Roentgenogram of maxillary sinus in which marked dulness of right antrum is to be noted. d: Lateral roentgenogram of head without evidence of involvement of other sinuses.

cidentally, infection of the maxillary sinus, secondary to dental infection, responds quickly to treatment. Since the associated dental system is largely obscured in the usual anteroposterior roentgenogram of the maxillary sinus, the rhinologist frequently overlooks the presence of dental infection, which may be

examinations. We prefer to make roentgenograms of all regions in the upper part of the mouth by placing the film in the vertical position, except in the molar region. This arrangement provides an exposure of more tissue above the bicuspid teeth. In children up to 5 years of age, the smaller intra-oral

films, or Raper's bitewing films, are used.

At the age of 5 years, the regular film is satisfactory. At this age, the maxillary sinus is small and the sinus is seldom evident in the roentgenogram. The floor of the nose or the hard palate frequently will be noted in these cases, but there is no shadow of the sinus.

One cannot definitely say that the presence of teeth retards pneumatization of the maxillary sinus, yet it will be noted, all through the growing years of childhood, that the developing teeth are closely related to the floor of the sinus and that, as the teeth develop, the sinus increases in size. (Fig. 9.)

Schaeffer[3] said: "It is well to remember, however, that the alveolar process of the maxilla is not fully pneumatized by the alveolar recess of the maxillary sinus until the time when the permanent teeth have erupted." In addition, there is, we believe, evidence that the alveolar process is further pneumatized when all of the permanent molar and bicuspid teeth have been lost.

The size of one of the maxillary sinuses may be decreased or reduced by a tumor, by a dentigerous cyst or a root cyst which is situated outside the sinus, and which displaces the walls of the sinus. Occasionally, the presence of osteitis deformans of the maxilla (Paget's disease), as reported by Stafne and one of us (L. T. A.),[4] may affect the size of the sinus to a considerable degree, and, at times, its shadow may be completely obliterated. (Fig. 10.)

From the evidence in the dental roentgenogram alone, it is difficult to state how frequently a correct diagnosis of infection of the maxillary sinus could be made in the routine examination of patients. The usual roentgenogram of the skull is much more dependable as definitely showing the sinus, and it provides

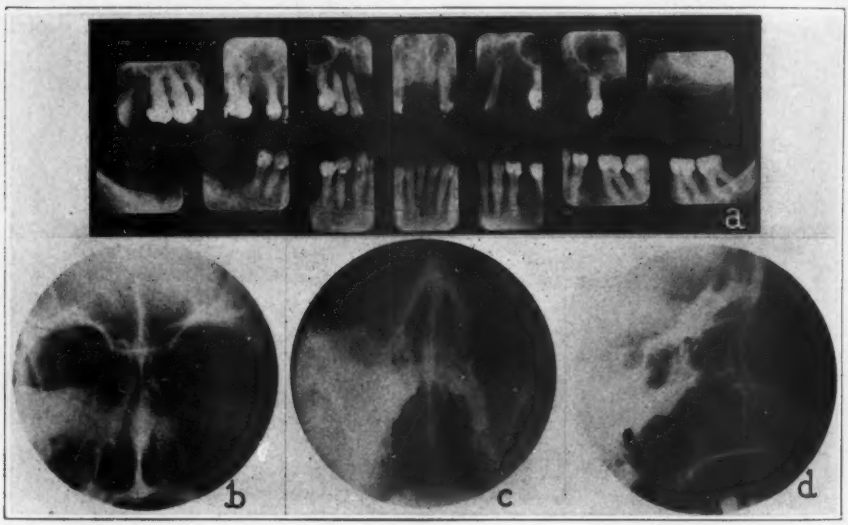

Fig. 6.—a: Dental roentgenogram showing cloudiness of left maxillary sinus in comparison with right, and pulpless upper left first molar, with region of rarefaction about mesiobuccal root, evident below floor of antrum. b: Roentgenogram of frontal sinuses. c: Roentgenogram of maxillary sinus showing marked dulness on left side. The patient was advised to have dental infection eliminated. There was a history of persistent sinus infection following operation on the antrum. This may have been related to the dental infection, which had not been treated. d: Lateral roentgenogram of head.

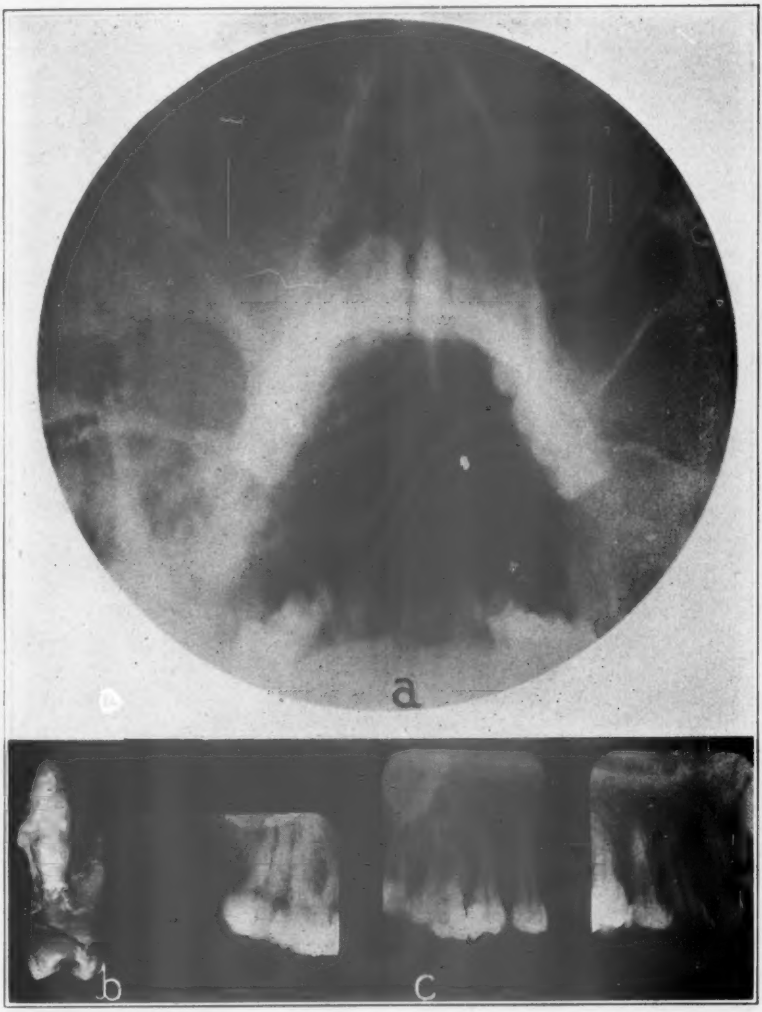

Fig. 7.—a: Roentgenogram of the maxillary sinuses showing dulness of left antrum. For several years, the patient had undergone treatment of the antrum with unsatisfactory results. Dental examination failed to reveal the infected tooth. b: Photograph of tooth removed, with granuloma attached. c: Dental roentgenogram of same patient showing rarefaction at root end of upper left second molar.

a good means of comparing the density, size and outline of the two maxillae, the orbits and the frontal and ethmoid sinuses.

In our series of cases, the patients had all had suppurative infection of the maxillary sinus. The dental roentgenograms were examined before the history and roentgenograms of the skull were studied. While we were aware that infection was present, we did not have information as to whether one or both of the maxillary

sinuses were involved or whether any evidence existed in the roentgenograms of the skull.

It was of interest that the dental roentgenograms did not show as much differentiation of density as did the roentgenograms of the head. However, we did not make a positive diagnosis of sinusitis on the basis of the dental roentgenogram since there was no evidence of such a condition in the roentgenogram of the head. We also did not exclude the presence of infection of the sinus in any case in which examination of the roentgenogram indicated the presence of an infection. The two roentgenograms agreed except as to the degree of cloudiness.

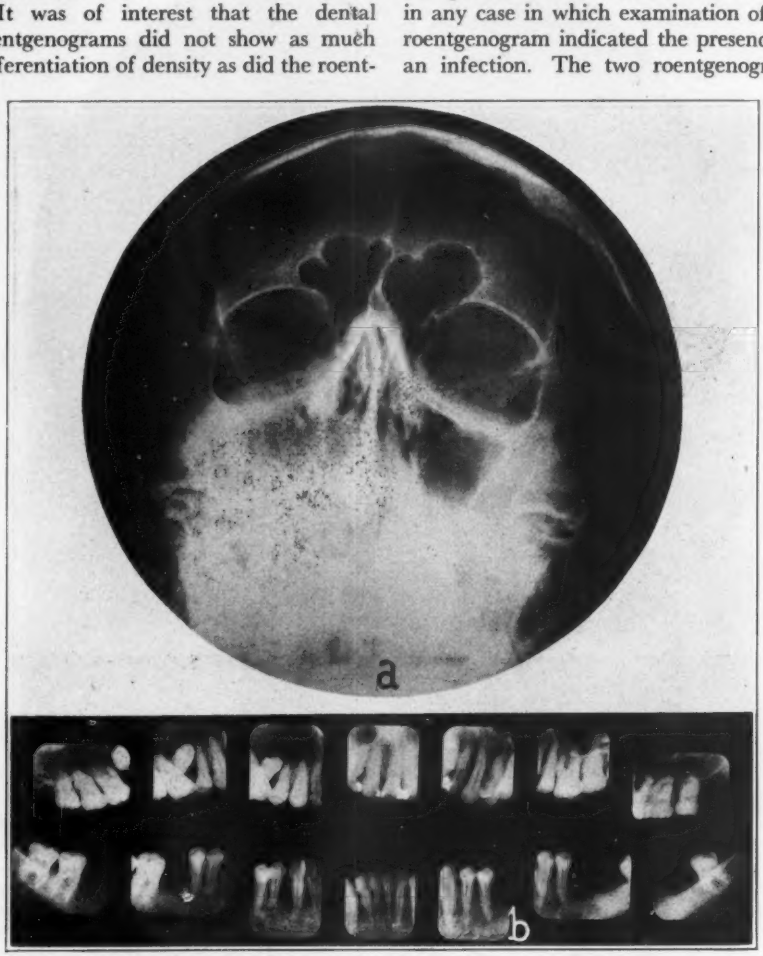

Fig. 8.—a: Roentgenogram of head showing cloudy left antrum. The dental complication was not recognized in this roentgenogram. b: Dental roentgenogram showing dentigerous cyst involving left maxillary sinus owing to impaction of upper left second bicuspid. There is considerable variation in size and color of the two maxillary sinuses. In the usual treatment of the antrum, the wall of the cyst was perforated. Infection resulted that was not controlled until the offending tooth was removed, together with the cystic membrane.

The patient visits his dentist more frequently than he does the rhinologist, and

roentgenograms of his teeth are made more frequently than are roentgenograms of his skull. The dentist therefore is likely to have first information regarding disease in the maxillary sinus.

Pain is not always associated with infection of the maxillary sinus. This usually occurs only when there is obstruction of the natural opening into the nose. The patient seeks the services of the rhinologist when he discovers an unusual drainage into his nose. When pain is present, it is apt to be associated, in the patient's mind, with some dental disorder. While the majority of infected sinuses are not related to teeth, there are times when the patient is benefited by being referred to the rhinologist, with a report of the evidence observed in the dental roentgenogram. The rhinologist, in turn, may have

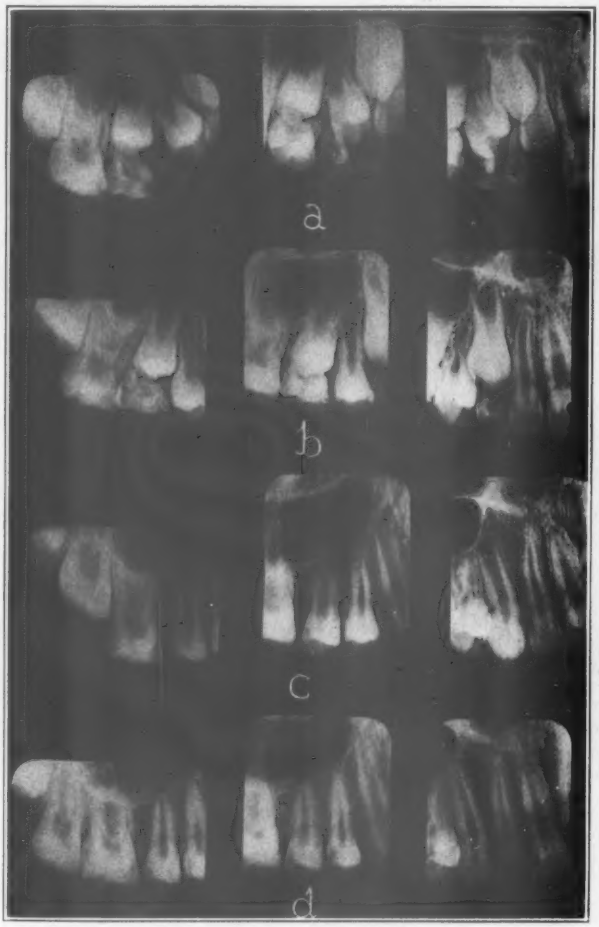

Fig. 9.—Series of dental roentgenograms of boy, showing size of maxillary sinus and the relationship of teeth to floor of maxillary sinus. a: Condition at 7½ years. b: At 8½ years. c: At 10½ years. d: At 12½ years.

information of importance for the dentist. For this reason, it is worth while for the dentist who is making use of the roentgenogram to become more familiar with the appearance of the maxillary sinus.

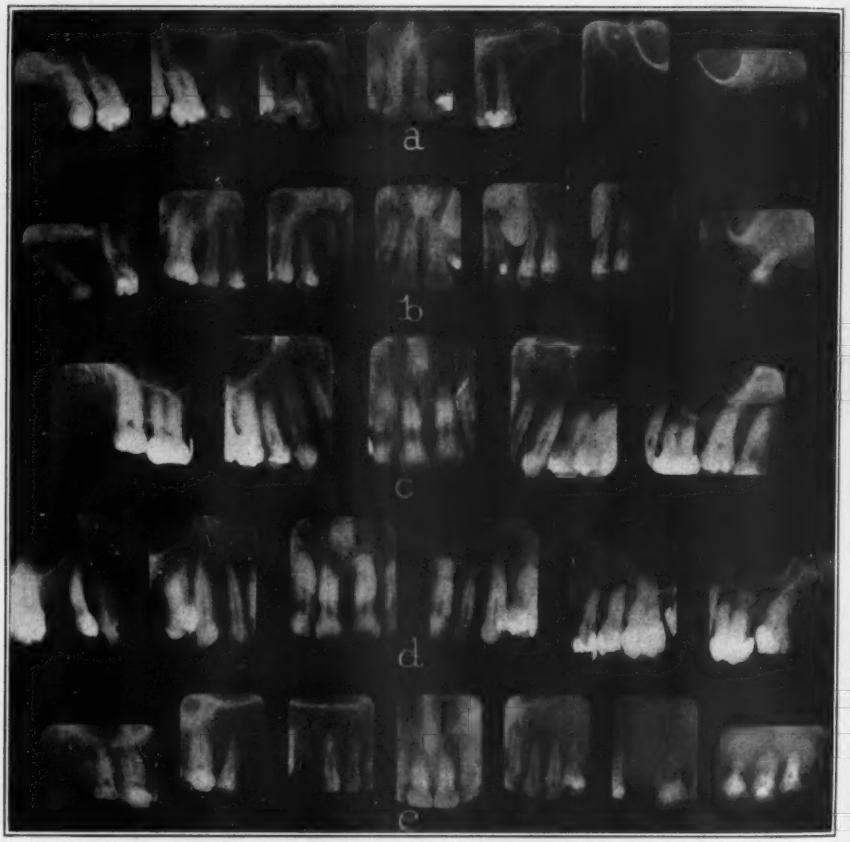

Fig. 10.—a: Dental roentgenogram of upper part of mouth showing increase in size of right maxillary sinus following removal of molar and bicuspid teeth. b: Dental roentgenogram of upper part of mouth. Comparison of the two maxillary sinuses shows increase in size of the right sinus after removal of first and second molars. c: Dental roentgenogram of patient who later had osteitis deformans of right maxilla. d: Roentgenogram of mouth of same patient, fourteen years later. One may note the decrease in size of the maxillary sinus on the right side. e: Dental roentgenogram of upper jaw showing obliteration of maxillary sinus on right side in case in which there was bony tumor in that region.

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THE IDENTITY OF AN ANTIBACTERIAL FACTOR IN THE SALIVA OF CERTAIN MAMMALIA

By S. Leonard Rosenthal, D.D.S.; Wallace M. McNabb, Ph.D., and Raymond C. Snyder, V.M.D., Philadelphia, Pa.

ATTEMPTS to induce oral Vincent's infection in normal animals by inoculation have been unsuccessful. While localized infection has resulted in some cases,[1, 2] it is not comparable with the disease in man. The lesions resemble localized abscesses. They heal spontaneously and the infection is not transmitted to other animals in contact with the affected animals.[3] The only typical Vincent's infection in laboratory animals has been the result of variations in diet[3, 4, 5] or injections of poisonous drugs.[6]

An investigation of this apparent immunity was begun by bacterjologic examination of the mouths of normal mammals. The observations on the undomesticated animals were made with the permission of the Zoological Garden of Philadelphia. Bright and dark-field smears were made from the gingivae of 50 dogs, 8 cats, 28 pigs, 2 horses, 1 rabbit, 1 guinea-pig, 1 rat, 1 rhinoceros, 1 hippopotamus, 2 elephants, 2 lion cubs, 1 baboon, 1 green monkey and 2 young chimpanzees. All smears were extremely mucinous. They were notable for their low bacterial count in comparison with man's and for the complete absence of motile micro-organisms. Fusiform bacilli or spirochetes similar to those common to the human oral cavity were not found, although three dogs, one rhinoceros, one elephant and one baboon yielded a short, thick spirochete with three or four curves which could not be identified. There were some exceptions to this general statement. A cat with a gingival ulcer and one with a broken canine tooth exhibited several typical *Spirochaeta vincenti* and *B. fusiformis* organisms. Three dogs, one with a severe gastro-intestinal disturbance, gave a similar picture. Smears from five pigs immediately following a meal of garbage contained several *Spirochaetae vincenti;* but it was impossible to determine whether these were alive, as no dark-field examination could be made. A 30-year old baboon with an extremely dirty mouth from which many teeth were missing gave a smear very similar to that of man. Spherical and rod forms were abundant. One leukocyte and three spirochetes were present in the stained smear, but the dark-field revealed no motility.

Apparently, the mouths of healthy animals contain antibacterial substances since their habits and diets must bring them in contact with innumerable spirochetal forms; yet not only is spirochetosis rare in these species, but also the spirochete is seldom seen in healthy specimens.

In an attempt to identify such a substance, saliva was obtained from twenty-five dogs, four cats, one green monkey, two horses and one rhinoceros. Salivation was induced by placing a few drops of a bitter substance, usually a 1 per cent aqueous solution of atropine sulphate, on the tongue and the dripping saliva was caught in a sterile glass funnel

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inserted in a sterile test tube. The horses were given a subcutaneous injection of choline chloride. In the case of the rhinoceros, an apple was held above the nostrils and the resultant drooling similarly collected.

The pH of all these saliva specimens ranged from 8.4 to 8.6 on the Beckman pH meter. The majority closely approximated the latter figure. They became more acid on standing, the pH dropping 0.1 or 0.2 every fifteen minutes. By heating the saliva to the boiling point and then placing it in a refrigerator, the pH could be kept stationary for several days.

shown that loss of motility in *T. pallidum* entails loss of pathogenicity. The test has the dual advantage of using microorganisms difficult or impossible of culture on artificial media, and inclusion of the natural organic matter which protects the bacteria in the mouth.

Contact with all normal animal saliva caused spirochetes and vibrios from a human mouth to lose motility instantly. Many instantly destroyed the motility of all bacilli also, but others failed to penetrate débris well or to stop the movement of all motile bacilli. In all cases, however, the majority of the bacilli lost their motility in five minutes. There was no effect

TABLE 1.—EFFECT ON MOTILITY*

Aqueous Solution	Spirochetes	Vibrios	Bacilli
Saturated solution $NaHCO_3$, pH 7.93	15†	15	15
Commercial buffered solution, pH 8.6	15	15	15
Na_2CO_3 buffered with $Na_2HPO_4 . H_2O$, pH 8.6	con‡	con	con
NaOH buffered with $Na_2HPO_4 . H_2O$, pH 8.6	15	15	15
Na_2CO_3 + NaCl, pH 10.05	con	con	con
NaOH + NaCl, pH 10.05	2	2	15
Molar solution Na_2CO_3, pH 11.0	con	con	con
Molar solution NaOH, pH 11.43	con	con	con

*The time necessary to stop movement is in minutes.
†Still motile at end of fifteen minutes.
‡Loss of motility at instant of contact.

Each specimen was subjected to the motility test,[7] which brings a definite quantity of the fluid the antibacterial properties of which are to be tested in contact under a dark-field microscope with an equal quantity of saliva from a patient with Vincent's infection. The saliva contains actively motile spirochetes, vibrios and bacilli together with the natural organic débris. The antibacterial properties are measured by the time elapsing from the moment of contact of the solutions to cessation of movements of (1) spirochetes, (2) vibrios and (3) motile bacilli. Eagle[8] and Kolmer[9] have

on the non-motile flora. Equal parts of human and of animal saliva in contact for fifteen minutes showed growth in all subcultures, and the animal saliva itself contained viable cocci and rods.

The 1 per cent solution of atropine sulfate used to induce salvation had no effect on motility, nor did human saliva from caries-immune and caries-susceptible individuals with healthy gingivae. Blood serum from these persons and from four of the dogs whose saliva was most efficient likewise was ineffective against the motile flora. The antibacterial action was therefore due to a con-

stituent of animal saliva. This action was not changed by filtration through a Jena G5/3 filter. Boiling increased the efficiency of animal saliva, but not that of saliva from man.

Yet oral fusospirochetal infection is not unknown in dogs kept as house pets.[10] In order to observe the antibacterial property of saliva in such cases, six dogs with this oral infection and one with black tongue were examined. The symptoms were similar to acute Vincent's infection in man: salivation, fetor, necrotic ulceration, tenderness, increased temperature and toxemia. In the dog subjected to the motility test.[7] None had any effect whatsoever on the oral flora of man. On the contrary, saliva from normal animals (except man) instantly destroyed the motility of the organisms from the sick dogs.

Three of these dogs recovered and were again tested. The mouths and flora were similar in every respect to those of normal animals. The saliva was pH 8.6 in each case, and all had regained the inhibitory effect on the motile oral flora.

Identification of the antibacterial substance now confronted us. The large quantity of mucin, which has an anti-

TABLE 2.—EFFECT ON GROWTH*

Aqueous Solution	Hormone Broth			Agar		
	Minutes			Minutes		
	5	10	15	5	10	15
Control	+	+	+	+	+	+
Saturated solution $NaHCO_3$, pH 7.93	+	+	+	+	+	+
Na_2CO_3 buffered with $Na_2HPO_4 . H_2O$, pH 8.6	+	0	0	+	+	+
NaOH buffered with $Na_2HPO_4 . H_2O$, pH 8.6	+	+	+	+	+	+
Na_2CO_3 + NaCl, pH 10.05	+	0	0	+	+	0
NaOH + NaCl, pH 10.05	+	+	+	+	+	+
Molar solution Na_2CO_3, pH 11.0	+	+	0	0	0	0
Molar solution NaOH, pH 11.43	+	+	+	0	0	0

*0 = no growth. + = growth.

with black tongue, the condition resembled noma in man, in which the tongue was primarily involved. Bacteriologic examination revealed many fusiform bacilli together with *S. vincenti, S. macrodentium, S. microdentium* and vibrios, all actively motile. The pH of this group was 6.7-7.6, about the range of saliva in normal man.[11, 12] Three additional cases were reported to us by A. T. Grayev, of Alabama Polytechnic Institute. The pH taken by color indicator was 7.6. In order to determine the inhibitory properties of such saliva, samples from each of the first six dogs were bacterial action,[13] is probably a factor. However, the fact that the substance readily passed through a fine filter and was not destroyed by boiling—indeed was intensified—pointed to an inorganic material.

Accordingly, a quantity of saliva from several dogs was evaporated to dryness. The white crystals with a strong saline taste remaining were dissolved in distilled water, and there resulted a clear, almost colorless solution, of pH 10.5, which stopped all movement instantly. Analysis proved this to be a mixture of sodium chloride and sodium carbonate. A mix-

ture of several specimens of saliva from man evaporated to dryness and redissolved gave a solution of pH 7.0 which had no effect on motility.

A mixture of saliva from several dogs was subjected to a qualitative analysis of the inorganic constituents. These were: phosphate, chloride, calcium, magnesium and possibly potassium, ammonia, sodium chloride, carbonate as sodium carbonate (Na_2CO_3) and sodium bicarbonate ($NaHCO_3$). Horse saliva also contained sodium carbonate, but human saliva and saliva from a dog with fusospirochetal infection contained sodium bicarbonate only. To confirm this analysis, saliva from 100 students was tested for the presence of sodium carbonate. None was found.

In order to determine whether the antibacterial action of sodium carbonate is an inherent property of the salt or is merely due to the susceptibility of spirochetes to changes in pH,[14] various solutions of similar alkalinity were tested for their effect on motility and for antibacterial action on the non-motile flora. The first determination was made by the motility test; the second, by mixing 4 parts of the solution and 1 part of a diluted mouth rinse, and subculturing in hormone broth and on agar slants. The results are shown in the accompanying tables.

Unquestionably, these results are not due merely to alkalinity.

Clinical tests were made on two dogs and five persons with acute Vincent's infection. Continuous topical applications of a molar solution of sodium carbonate were made to the dried gingival tissues for fifteen minutes. Home care was limited to hourly rinsing or topical application with this solution. Resolution was rapid in all cases.

From these experiments, we conclude that:

1. The saliva of normal animals contains sodium carbonate, which inhibits the motile oral flora of man, but has little effect on the non-motile bacteria.

2. This salt is absent in man and may disappear from individual animals, which then become predisposed to fusospirochetal infection.

3. A laboratory animal suitable for experiments on Vincent's infection must be one whose saliva is normally free from this salt.

4. Solutions of sodium carbonate are of value in the treatment of Vincent's infection.

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DENTURE BASE MATERIAL: ACRYLIC RESINS

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INTRODUCTION

An investigation of the physical properties of acrylic resins used as denture base materials was undertaken by the American Dental Association Research Fellowship at the National Bureau of Standards during the past year. Acrylic resins have been used with considerable success in the industrial field for such purposes as for airplane windshields and novelties. Since these resins are now widely used by the dental profession, it was thought desirable to have more information on their physical properties which have a dental significance.

The development of the clear and light-stable methyl methacrylate type of acrylic resin enabled the manufacturer to produce a denture base material which would maintain its color and translucency, and thus give a lifelike appearance. It is the combination of the proper translucency and color that imparts the natural appearance and masks the artificiality of the restoration.

In order to obtain a comparative idea of the value of the methyl methacrylate resin, use was made of a table of properties of various plastics published in October 1938 in *Modern Plastics*. A study of the values in this table indicates that methyl methacrylate resin should be satisfactory for a denture base. Methyl methacrylate resin compares favorably in strength, density, molding characteristics and toughness with hard rubber, which has been the most used and probably the most satisfactory denture base material from the standpoint of both mechanical properties and clinical experience. It is the purpose of this paper to show how methyl methacrylate resin compares with denture base rubber and other materials used for denture construction. Tests were made on shelf life, curing, color stability, dimensional change and such mechanical properties as strength and hardness.

MATERIALS INVESTIGATED

The materials investigated (Table I) were obtained in the regular trade channels and are considered representative of the acrylic resins being furnished to the profession at the time of this investigation.

SHELF LIFE OF ACRYLIC RESINS

In order to determine the amount of time that the dentist may safely store units of acrylic resins, a series of tests on shelf life were carried out in which specimens of resin were stored at 5° C., room temperature (approximately 25° C.), 37° C. and 43° C., after which their moldability was determined. These temperatures were chosen as representative of temperature ranges encountered in shipping or in dental offices. Observations were made at various intervals of time; namely, four, eight, eleven, fif-

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teen and forty-five days and two and one-half months. After each of these intervals of time, the specimens of resin No. 3 (Vernonite) were packed in denture flasks to determine whether they were still sufficiently plastic to be adapted to the mold. The progress of the storage cure was very slow at the lower temperatures and very fast at the higher temperatures, with the result that this material was considered satisfactory for use after storing, as follows: (1) for at least two and one-half months at 5° C. (41° F.); (2) for fifteen days at room temperature (approximately 25° C. [77° F.]); (3) for one week at 37° C. (99° F.), and (4) for one day at 43° C. (109° F.).

TABLE 1.—MATERIALS INVESTIGATED

Trade Brand	Acrylic Resin	Manufacturer or Distributor	Address
Crystolex	No. 1	Detroit Dental Mfg. Co.	Detroit, Mich.
Lucitone	No. 2	The L. D. Caulk Co.	Milford, Del.
Vernonite	No. 3	Vernon-Benshoff Co.	Pittsburgh, Pa.

TABLE 2.—MECHANICAL PROPERTIES OF DENTURE BASE MATERIALS

Trade Brand	Material	Transverse Tests at 37°C.				Tensile Strength at 25±3°C.	
		Deflection* at Load of			Breaking Load		
		4000 Gm.	5000 Gm.	6000 Gm.			
		Mm.	Mm.	Mm.	Gm.	Kg./Cm.²	Lb./In.²
Crystolex	Acrylic resin, No. 1	2.25	3.73	7.06	6100	575	8200
Lucitone†	Acrylic† resin, No. 2	2.01	2.98	4.30	7000	685	9700
Vernonite	Acrylic resin, No. 3	1.79	2.72	3.91	8000	641	9100
Ash's Dark Elastic	Olive base rubber	1.68	2.77	3.64	8000	555	7900
S. S. White's Veneer Light Pink, No. 3	Pink veneer rubber	1.38	3.36	4.46	6800	450‡	6400‡

*Deflection measured from initial load of 1500 gm.

†This material contained many bubbles when received and was difficult to mold into a solid cake free from holes.

‡Tensile properties not on same rubber as other properties listed. (J.A.D.A., 23:1500, August 1936.)

TABLE 3.—INDENTATION HARDNESS OF DENTURE BASES
(Knoop Method)

Trade Brand	Material	Indentation Hardness Kg./Mm.²
Resovin	Vinyl resin	13.0
Atlantic Gold Dust Rubber	Metal filled base rubber	13.2
Ash's Dark Elastic	Olive base rubber	13.4
S. S. White Maroon Rubber	Maroon base rubber	15.8
Ash's Gum Pink	Veneer rubber	16.4
Crystolex	Acrylic resin No. 1	17.5
Vernonite	Acrylic resin No. 3	17.6
Lucitone	Acrylic resin No. 2	20.3
Luxene	Phenol-formaldehyde resin	27.0

TABLE 4.—CURING SHRINKAGE OF DENTURE BASE MATERIAL

Trade Brand	Material	Linear Shrinkage* Per Cent
Crystolex	Acrylic resin, No. 1	0.44
Crystolex	Acrylic resin, No. 1	0.50
Crystolex	Acrylic resin, No. 1	0.47
		Average 0.47
Lucitone	Acrylic resin, No. 2	0.54
Lucitone	Acrylic resin, No. 2	0.59
		Average 0.56
Vernonite	Acrylic resin, No. 3	0.57
Vernonite	Acrylic resin, No. 3	0.62
Vernonite	Acrylic resin, No. 3	0.47
		Average 0.55
Ash's Dark Elastic	Olive base rubber	0.40
Ash's Dark Elastic	Olive base rubber	0.26†
Ash's Dark Elastic	Olive base rubber	0.28†
		Average 0.31
S. S. White's Maroon	Maroon base rubber	0.47

*These values are considered accurate to ±0.05.
†These specimens were 4 mm. thick; all others, approximately 10 mm. thick.

TABLE 5.—RÉSUMÉ OF CHANGES IN DENTURES IN SERVICE

Case	Type of Denture	Base Material	Time in Service	Change Across Posterior Area Per Cent	Fit on Model	Color Change
1	Full lower	Aldenol	1 month	−0.35	Satisfactory	None
2A	Full upper	Duratone	1 year	Excessive shrinkage	Not satisfactory	Very unsatisfactory
2B	Full lower	Duratone	1 year	−0.44	Satisfactory (tight)	Slight fading
3	Full upper	Aldenol	3 months	+0.15	Not satisfactory	Brownish
			1 year	+0.54	Not satisfactory	Brownish
5A	Full upper	Vernonite	1 month	+0.24	Satisfactory	None
			9 months	+0.59	Satisfactory	None
			17 months	+0.51	Satisfactory	None
9	Full upper	Vernonite	7 months	+0.06	Satisfactory	Slight darkening around two teeth
11A	Full upper	Rubber	6 months	−0.11	Satisfactory	Stained
			15 months	+0.08	Satisfactory	Stained
11B	Full lower	Rubber	7 months	−0.04	Satisfactory	Stained
			15 months	−0.11	Satisfactory	Stained
12	Full upper	Luxene	1 month	−0.52	Satisfactory	None
			5 months	−1.04	Satisfactory (tight)	None (some stain)
			13 months	−1.55	Not satisfactory	Faded and stained

The specimens used in this series of tests were sealed in glass containers in order to prevent evaporation and the rapid cure which takes place in the presence of oxygen. It was observed that specimens left in the atmosphere were cured much faster than those stored in sealed containers. Therefore, units should be stored in the dark and in a closed container at the temperature ordinarily

obtained in a household refrigerator, since oxygen, ultraviolet light and heat are known to promote the polymerization of this resin.

Acrylic resin No. 1 (crystolex), which is furnished in the form of a powder and a liquid, showed no apparent change in working qualities when stored at laboratory temperatures (25 ± 5° C.) for more than a year. This is probably because of the presence of an inhibitor added to prevent polymerization at lower temperatures. The powder and liquid are mixed immediately before use and have a distinct advantage in shelf life over the materials furnished in the form of a plastic cake.

Curing.—One of the desirable features of these resins is the ease with which they can be packed and cured. The material furnished in the form of a plastic cake is packed similarly to rubber; that is, the cake is placed in a warm mold (approximately 77° C. [170° F.]) and the flask is closed in a compression clamp. The flask, after closing, is placed either in boiling water or in a vulcanizer for curing. The material will be cured satisfactorily in thirty or more minutes at the temperature of boiling water. The plaster is easier to remove from the denture if it is cured in a vulcanizer at 138 to 149° C. (280 to 300° F.) for thirty minutes or more. The material is not sensitive to overcuring at these temperatures. When the resin is furnished as a liquid and a powder, the two are mixed in definite proportions to form a plastic mass, which is packed into a warm mold much the same as the plastic cake. The model should be covered with tinfoil before packing in order to get the best results. After the cure is completed, the denture should be allowed to cool to room temperature before removal from the flask, as otherwise it may be distorted.

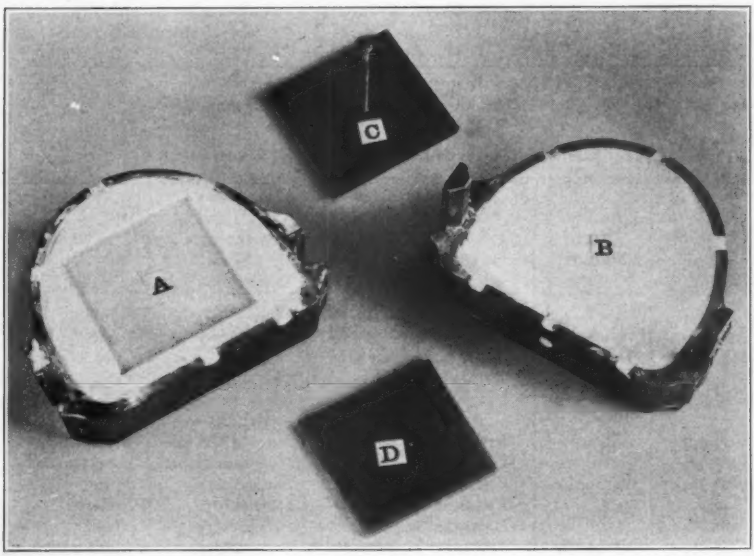

Fig. 1.—Mold for forming resins. A and B, flask; C, mold form; D, cake of cured resin.

Color Stability.—Specimens of the three acrylic resins were placed in an apparatus[1] used for studying the weather-

ing effects of paints, varnishes, etc., and used previously[2] on denture base materials. These specimens were exposed to the radiation of a carbon arc lamp and were sprayed with water. No change in color was detected after twenty-nine hours' exposure. Observations on dentures in service confirm these accelerated tests.

PHYSICAL PROPERTIES

The test specimens used in the determination of the physical properties

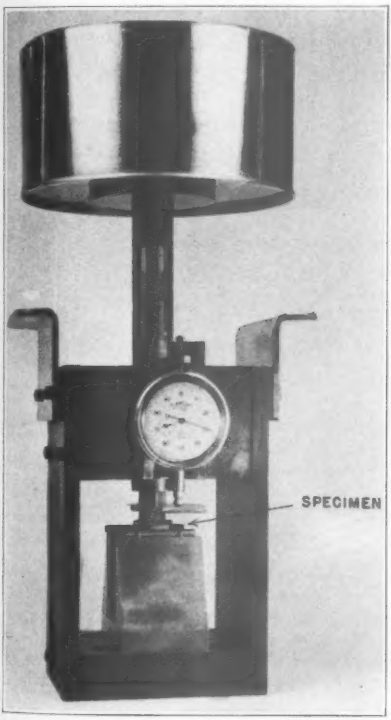

Fig. 2.—Instrument for determining transverse properties of denture base materials.

were machined from cakes of material cured in plaster molds. (Fig. 1.) These cakes were approximately 65 by 63 by 4 mm. when molded. The test specimens were machined to 65 by 10.0 by 2.5 mm., with a tolerance on the width and thickness of ±0.03 mm. They were finished smooth and flat.

The materials were cured as described by the manufacturer's directions which accompanied the packages. The methods of making the tests will be briefly described and then the results will be compared with those obtained on rubber.

Transverse Test.—The specimens were stored in a constant-temperature air bath at 37 ± 0.5° C. for several hours before the tests were conducted. The instrument used in making the test is shown in Figures 2 and 3. It was so constructed that the specimens could be tested by the application of a concentrated load to the center of a 50-mm. span at 37° C. The deflection was measured on a sensitive dial indicator which was graduated in hundredths of a millimeter. An initial load of 1,500 gm. was applied to the specimen and the reading of the dial indicator was considered as the zero reading. Load increments of 500 gm. were gradually applied during a thirty-second interval. Thirty seconds later, the deflection was observed on the dial indicator. This procedure was repeated until the specimen failed. The results of the average of three or more tests are shown in Figure 4 and Table 2. Data on base rubber tested in a similar manner are included for comparative purposes.

Tensile Strength.—The tensile strength of the materials (Table 2) was determined at room temperature in a 600-pound Amsler hand-operated testing machine. The load was applied slowly and uniformly up to the stress necessary to rupture the specimen, which required about three minutes.

Hardness.—The hardness of the materials was determined by the Knoop[3] indentation method using a 50-gm. load on a diamond pyramid. The diamond was in contact with the specimen for five

seconds. The length of the impression from which its area was computed was measured with a micrometer microscope. The ratio of the load applied to the area of the indentation, expressed in kg/mm.,² is shown in Table 3. The materials are arranged according to their relative hardness, the lower the number, the softer the material. The determinations were made at room temperature (25-30° C.).

Comparison of Mechanical Properties.—From a study of Figure 4 and Table 2, a comparison of acrylic resins with olive base rubber and veneer rubber can be made. The transverse test data indicate that acrylic resins were not so stiff as a typical sample of olive

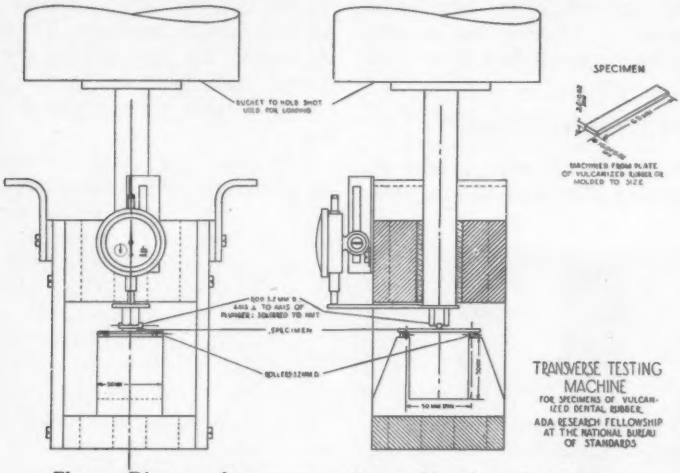
SPECIMEN
TRANSVERSE TESTING MACHINE
FOR SPECIMENS OF VULCANIZED DENTAL RUBBER.
ADA RESEARCH FELLOWSHIP AT THE NATIONAL BUREAU OF STANDARDS

Fig. 3.—Diagram of transverse testing machine shown in Figure 2.

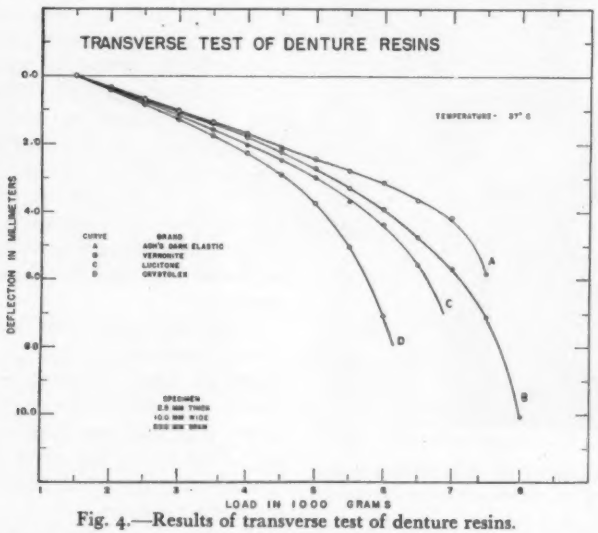

Fig. 4.—Results of transverse test of denture resins.

base rubber. For example, acrylic resin No. 3 (vernonite) shows a deflection curve that closely approximates the olive base rubber, while the other two materials are somewhat more flexible. The maximum strengths of the acrylic resins are, in general, of the same magnitude, ranging from 6,100 to 8,000 gm., while the breaking loads for olive base and veneer rubber were 8,000 and 6,800 gm., respectively. The tensile strength of the acrylic resins was higher than that of the rubbers. The indentation hardness numbers (Table 3) are of the same order as those of other denture bases. The numerical values for hardness are above those for the rubbers tested and below those for the phenol-formaldehyde resin.

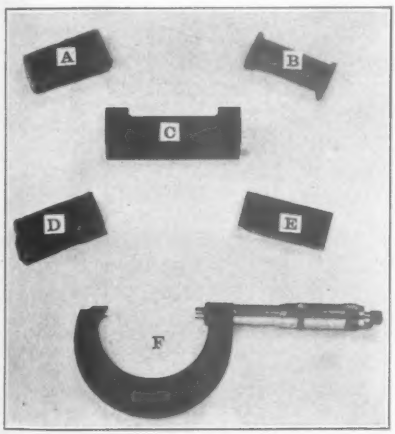

Fig. 5.—Equipment used to determine linear curing shrinkage of denture base materials. A and B, specimens of acrylic resins; C, stainless alloy block in which material is cured; D and E, specimens of denture rubber; F, micrometer caliper.

DIMENSIONAL CHANGE

Shrinkage on Curing.—In order to determine the dimensional accuracy with which a denture base material may be expected to reproduce the dimensions of the model, the following method for measuring the linear shrinkage of denture base materials during curing was devised. The method consists in packing a sample of denture base material in a metal block of known dimensions. This block was invested in a dental flask similarly to the investing of a dental model. The material was treated in identically the same manner in making the shrinkage test, so far as packing and curing are concerned, as it would be in making a denture.

The shrinkage test block is shown in Figure 5. The inside end faces on the cut-out portion of the block are parallel and flat. The block is constructed of stainless alloy of known thermal expansion. To determine the linear shrinkage of the denture base material: (1) the length, at room temperature, of the cut-out portion of the block was measured; (2) the length, at room temperature, of the test piece after curing was measured; (3) the difference between these lengths, divided by the length of the cut-out portion of the block (after a correction for its length change from room temperature to the temperature at which the denture material ceases to flow was made) times 100, gives the shrinkage in per cent.

Table 4 shows the results obtained on three acrylic resins and two denture rubbers. The shrinkage of acrylic resins varied from 0.47 to 0.56 per cent. That of the olive base rubber was somewhat lower, 0.31 per cent, and of the maroon rubber, 0.47. These determinations are considered accurate to ± 0.05; therefore, the acrylic resins showed slightly higher shrinkage than the olive base rubber and approximately the same as the maroon rubber. Different shapes of specimens of the acrylic resins gave no appreciable variations in results, while thin specimens of rubber gave slightly lower values than thick specimens. From the foregoing observations, it would be expected that an acrylic resin would give as satisfactory fit as rubber. Both, however, would be somewhat undersize.

Another simple method was devised for measuring the shrinkage of plastic materials during curing. It consisted of etching lines on a pyrex glass plate and curing the material in contact with this surface. The lines will be reproduced as ridges on the specimen. They may be measured separately on the plastic and the glass, or by placing the glass over the plastic and observing the difference between the lines on the plate and the ridges on the material. Uncured denture material was placed between two glass plates, one of which had lines on it. Only enough pressure was applied to insure contact between the plastic and the glass. This procedure offers a minimum resistance to the shrinkage of the material. Acrylic resin No. 3, by this method, had a shrinkage of 0.63 per cent. This method seems very promising for the study of shrinkage of plastic materials.

Dimensional Change of Acrylic Resin Denture.—The effect of change in environment on warpage was studied on a denture made from acrylic resin No. 3 (vernonite). The denture was prepared by the regular dental procedure and was stored for sixty days at a constant relative humidity of 32 per cent in order to stabilize the resin to a constant condition. The denture was then stored in distilled water at 37° C. for twenty-seven days. During this twenty-seven-day interval, it was frequently weighed and observations were made on marks on the denture to determine what change in dimension was taking place while the denture was immersed in water. The denture was then removed from the water and stored in air at 32 per cent relative humidity. The change in dimension and the change in weight of the denture caused by wetting and drying are shown in Figure 6. These curves show that the dried denture expanded when immersed in

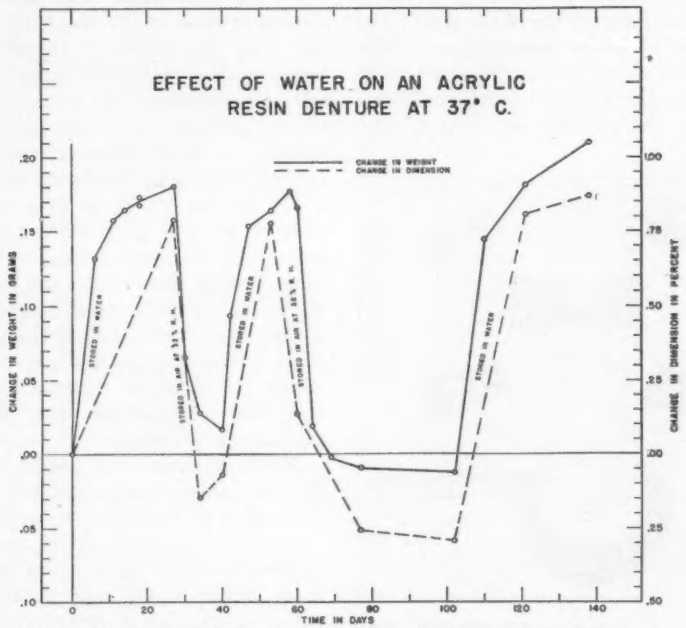
EFFECT OF WATER ON AN ACRYLIC RESIN DENTURE AT 37° C.
CHANGE IN WEIGHT
CHANGE IN DIMENSION
CHANGE IN WEIGHT IN GRAMS
CHANGE IN DIMENSION IN PERCENT
TIME IN DAYS
STORED IN WATER
STORED IN AIR AT 32% R.H.

Fig. 6.—Effect of water on acrylic resin denture at 37° C.

water and that the wetted denture shrank in air.

Before the denture was immersed in water, a gypsum model of its bearing surface was prepared. When the denture, after immersion in water for several days, was replaced on the model, it could be clearly seen that it did not fit accurately. A study of the data (Fig. 6) indicates also that the cycle of dimensional change is reversible; that is, when the denture was alternately subjected to wetting and drying, it returned approximately to its original dimension.

The change in dimension observed on this denture indicates that occlusion should be adjusted when the denture has become saturated with moisture and that the denture should not be allowed to dry out thereafter.

OBSERVATIONS ON DENTURES IN SERVICE

In order to obtain some information on what changes are taking place in the material after the denture is placed in service, a few practical cases were constructed in cooperation with the Army Dental Corps, the University of Pittsburgh Dental School and the Georgetown University Dental School. Models of the bearing surface of each of the dentures were made after the case was ready for insertion in the mouth. Marks were placed on the dentures on which observa-

Fig. 7.—Gypsum model and denture used to study warpage of base materials.

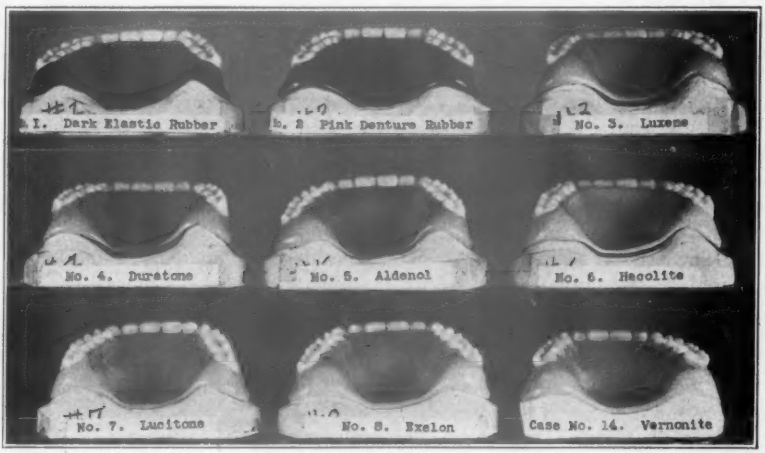

Fig. 8.—Dentures replaced on models after fifteen days' storage at 37° C. The amount of space between denture and model indicates the fit.

tions with a microscope could be made for the determination of the dimensional changes. The models were stored at a constant relative humidity of 32 per cent and were made from the same dental stone.

These dentures were examined from time to time by visual inspection and microscopic measurements to ascertain what changes in color and shape, respectively, were taking place. To determine the fit, the denture was placed on the model. If there was no space visible between the model and the bearing surface of the denture, the fit was considered satisfactory. A résumé of the observations is given in Table 5. While these observations cover only a few cases, which may not be representative samples of dentures in service, they do give some very interesting information.

The study of these dentures indicates that a dimensional change of more than 0.5 mm. occurred in one denture in the negative direction (Table 5, Case 12), while another showed a positive change of more than 0.25 mm. (Table 5, Case 5A). A full upper denture (Table 5, Case 2A), after one year's service, would not go to place on its model by 1.5 mm. at the posterior palatal periphery. In all of these cases, the patients said that the dentures gave them satisfactory service and caused no discomfort in the mouth.

The cases are too few for any general conclusions, except that the dentures made of phenol-formaldehyde resins were not color-stable in service and the acrylic resins were far superior in this respect.

Warpage of Dentures.—In order to study the change in fit of dentures when they are placed in service, nine similar full dentures were made for one master model. A stone model of the bearing surface was made of each denture after it was polished and finished. A sample of the stone model and a denture are shown in Figure 7. Of the nine dentures, two were rubber, three were phenol-formaldehyde resins, one was a cellulose compound and three were acrylic resins. All of the dentures were made of materials purchased in the open market, and they were processed by a commercial dental laboratory according to the directions accompanying the respective materials. These dentures were then stored in water at approximately 37° C. for fifteen days and were replaced on their respective stone models. The results are shown in Figure 8. It is evident from a study of this photograph that some of the dentures so treated warped appreciably. In fact, some did not go to place on the model by as much as 1 to 2 mm. in the palatal area. The dentures made from rubber and the acrylic resins showed less warpage than the phenol-formaldehyde resin dentures. As the first eight of these dentures were made up and treated identically and the ninth (No. 14) comparably, it seems quite significant that there was a large variation in dimensional stability. These dentures will be subjected to other changes in environment and their fit observed on these models.

CONCLUSIONS

Physical and chemical tests on three acrylic resins used as denture base materials indicate that:

1. They compare favorably with vulcanite in nearly all mechanical properties which have dental significance.

2. They are superior to rubber in ease of curing, and in the properties which give better esthetic appearance (color and translucency).

3. Accelerated laboratory tests and actual service tests show the material to be color-stable under oral conditions.

4. The shelf life of the material, when furnished in the partially polymerized state (plastic cake), is short at room temperature (25° C., 77° F.), but the material may be stored satisfactorily for several months at 5° C. (41° F.).

5. The material furnished in a liquid and a powder had a satisfactory shelf

life of more than a year at room temperature (25° C., 77° F.).

6. Laboratory tests and observations of dentures made of acrylic resins of the methyl methacrylate group indicated that, in general, they gave as satisfactory service as dentures made of rubber. In fact, when all factors are considered, these resins appear to be the most satisfactory plastics currently used for denture bases.

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DAVID L. ROGERS, FIRST TO EXCISE THE MAXILLA

By Walter H. Jacobs, D.D.S., New York City

It often happens that, in our desire to acclaim those who have served us well, we overlook the obscure pioneers whose lesser contributions to the healing art have paved the way for far-reaching advances. Our profession, as a whole, is not properly acquainted with the men whose early efforts helped to raise the dental-surgical art to the high standard of today. This brief biography of David L. Rogers may help to stimulate interest in the dental and medical history so closely woven in the surgery of the head, face and mouth.

While we know that the early surgeons performed lithotomies, amputations, plastic operations, trephining of the skull and other major operations, it is not until we come to the time of Acoluthus of Breslau in 1693 that we note the first recorded partial resection of the lower jaw.[1] In 1810, an American surgeon, William Henry Deadrick, of Winchester, Va., made a successful excision of part of the lower jaw. In 1821, Valentine Mott, prominent New York surgeon, removed the right side of the lower jaw after tying the carotid artery. By far the most radical operation about the face, up to this time, was made in 1820 by another American surgeon, Horatio G. Jameson, of York, Pa. Dr. Jameson removed a tumor of the upper jaw, and, owing to the nature of the growth and its size, it was necessary to remove a good portion of the maxilla. But, as the operator himself says, in describing the removed mass, "the body of the maxillary bone was a good deal broken up but not entirely removed."[2]

In 1824, David L. Rogers was called upon to remove a tumor of the upper jaw. Dr. Rogers' report of the operation, "Case of Osteo-Sarcoma of the Superior Maxillary Bone with the Operation for Its Removal,"[3] will best describe the extent and method of his procedure.

It being evident that unless some energetic measures were adopted to arrest its progress, it must soon terminate his existence, I therefore determined to attempt its extirpation. The operation was accordingly performed on the tenth (May 1824), in the following manner:—An incision was made first through the filtrum of the upper lip, which was dissected from the tumor and the alae of the nose, so as to turn both portions of the lip over upon the cheek. The second incision was to detach the cartilaginous portion of the septum narium from the top of the tumor. After extracting the two first molar teeth on each side, a fine saw was used which readily divided the superior maxillary bone, including the palatine process, the two incisions meet-

ing at the palatine suture; after sawing through the principal bones, the tumor was easily removed, although it extended much further back than was first anticipated. It was found necessary, during the operation, to remove the two inferior turbinated bones, a part of the septum narium, the vomer, and a part of the right antrum. Only a small quantity of blood was lost during the operation, considering the extent of the disease, and the vascularity of the part; this may be attributed to the frequent use of the saw. After the operation, the soft parts were brought together and secured by three sutures and adhesive straps. No unpleasant symptoms occurred during his recovery. The parts adhered by the first intention. There was considerable falling in of the upper lip, in consequence of the support which it gave to the nose. In two weeks from the time of the operation, the patient was able to walk out, and on the fourth, to return to his daily labor. The situation of this man will be rendered comparatively comfortable with the assistance of a cork palate.

Somehow, the mistaken impression that Rogers removed both maxillae became accepted in medical and dental history. Garretson says, "In 1824 Dr. David Rogers, of New York, exsected both superior maxillae."[4] Packard writes, "In 1824 David L. Rogers reported, in the *New York Medical and Physical Journal,* a case in which he had removed both superior maxillae and the patient recovered."[5] These references may have been taken from the newspaper obituary, part of which reads, "He (Rogers) was the first in America to remove the upper jaw."

An examination of Rogers' description of the operation leads one to believe that this was not the case. Furthermore, as a footnote to the description of the operation published in his "Surgical Essays and Cases in Surgery," in 1849, Rogers writes, "So far as I have been able to discover from the records of surgery, this is the first case in which the superior maxillary bone has been removed by a surgical operation."

The operation performed by Rogers was a subtotal resection of both maxillae. Even today, this is considered a most radical operation, and it speaks highly for the phenomenal skill and daring of the operator, particularly when we consider that it was performed twenty years before Horace Wells discovered anesthesia, and forty-three years before Lord Lister and antisepsis!

David L. Rogers was born in Mamaroneck, N. Y., July 7, 1799. He belonged to a family which had produced eminent professional men, ministers, physicians and lawyers, and it was not by chance that Rogers became a surgeon. His grandfather was a surgeon under the command of General Stillman during the War of the Revolution; and his father was also a surgeon.[6]

At the age of 23, Dr. Rogers graduated from the College of Physicians and Surgeons in New York City. His skill as an anatomist and dissector became evident soon after he entered practice and helped him to obtain success in his profession. When, in 1826, the faculty of the College of Physicians and Surgeons resigned in a body because of difficulty with the regents of the state and organized another medical school, Dr. Rogers was chosen to give lectures and demonstrations in operative surgery under Dr. Mott.[7] His dexterity as an operator was augmented by an ability to design and introduce new instruments into the then fast growing art of surgery.

In 1829, he brought out a new instrument for the operation on fistula *in ano.* In 1831, he devised an instrument for the performance of tonsillectomy that was the very best designed for the purpose up to that time.

It was not long before Dr. Rogers developed one of the busiest practices of his day. Hour upon hour, he devoted to operating, dressing wounds, visiting patients and even coaching a group of medical students, who flocked about him because of the clearness of his anatomic demonstrations. This great amount of

work brought on a serious nervous breakdown, and Rogers, then at the height of his career, had to retire from active practice.

Learning of his intention to retire, the faculty of the Geneva Medical College, New York, invited him to take the chair of surgery in that institution. He accepted the position, but, after three sessions, even this was more than the health of the overworked surgeon could stand and he had to resign the post. From time to time, during the succeeding years, Dr. Rogers allowed himself to be consulted in important cases. When the New York Ophthalmic Hospital was opened in 1852, Dr. Rogers was appointed a staff surgeon.

At the beginning of the Civil War, Rogers offered his services to the government. He formed one of the volunteer corps of surgeons from the State of New York. He was present at all the great battles before Richmond in the early stages of the war and afterwards accompanied the Army of the Southwest and was on the staff of General Banks, acting as medical director. Exposure during the War, especially before Richmond, seriously affected his health, and gradual decline terminated in his death, November 10, 1877.[8]

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124 West Ninety-Third Street.

STRETCH FLAP AND TISSUE MOLDING IN ORAL SURGERY

By Harry G. W. Voss, D.D.S., Racine, Wis.

A CLOSE study of Nature's method of closing cuts and wounds shows, according to my interpretation, a slow contractive molding of the tissue edges. This slow contraction is caused by the shrinkage of the fibrin in the blood clot, which pulls the tissue edges together as closely as possible. In the mouth, the action of the tongue, cheeks and lips aids in this slow molding process. I believe that dentists can greatly assist in and hasten this process of healing by carefully kneading and molding the tissue edges after oral surgery, thereby avoiding much postoperative trouble, especially "dry socket." It was found that the more extensive the operation, the greater the repair and healing necessary. It was also found that any transverse severance of a muscle layer caused the edges of the wound to pull apart, thereby necessitating the use of sutures to reapproximate the tissue edges. This technic was developed to reduce these disadvantages to a minimum, by aiding Nature.

A great variance will be noted in many cases, if the mucosa overlying the alveolar ridges is observed. Some mouths present a thick layer of tissue, and others present a membrane that is thin and delicate. Much care must be exercised in using this technic when there is a thin mucous membrane because the tissue will tear under the tension of stretching.

The stretch flap technic is indicated in cases of pyorrhea operations performed in sections, in minor oral surgery for the removal of difficult teeth and in cases which give a history of postoperative trouble.

The instruments used in this stretch flap operation consist of a small beavertail burnisher, a periosteal elevator, a bone file, a rongeur, tissue scissors and whatever other instruments are necessary for the operation at hand.

The stretch flap is started by peeling the mucous membrane away from the necks of the teeth at the gingival portion. This skinning process is best done with the periosteal elevator, or the beavertail burnisher, whichever is better suited for the particular case. As this flap is reflected toward the root ends of the teeth, it will stretch, thus making the stretch flap. The flap is lengthened in a mesial to distal direction until the field of operation is properly exposed. In some cases, both the buccal and the lingual flaps will be necessary. In other cases, the buccal flap will be sufficient. The mucosa must be carefully handled so that it will not be torn. The elastic fibers in the gum tissue will give or stretch slowly if even pressure is used in reflecting the flap. Sometimes, it will be found that this membrane will resist the peeling back process owing to the strong interproximal tissue attachments. In these cases, it will be necessary to sever the interproximal tissue connections before reflecting the flap. The operation at hand can then be performed after the field is clear.

After the operation is completed, the field should be carefully rechecked to see that all sharp bony edges, spicules, chips, swabs, broken fillings, etc., have been removed. The site is then flooded with compound solution of iodine or a diluted tincture of iodine, worked well down to the base of the sockets with a cotton swab. The reflected flaps are then carefully replaced. Light finger pressure is applied to the edges of the flaps, endeavoring to cover the area operated upon with the mucous membrane. This digital pressure will often reveal sharp edges of bone, and often the thin buccal or lingual plate of process will crack under the pressure. If sharp edges are noted, the field of operation is reopened and these edges or pieces of process are removed to facilitate healing, and thus the patient is made more comfortable. In some cases, the tissue flaps will not cover the operative area, and it will be necessary to trim some of the process away so that the flap edges will approximate each other almost to the touching point. Sometimes the flap edges will overlap, and it then will be necessary to trim the tissue edges so that they almost meet. If this is not done, a spongy ridge will result.

The object of the stretch flap is to cover the operative field with tissue, and to try to get a straight line healing by first intention. Suturing these edges is not entirely necessary. This open wound technic provides for ample drainage, and is followed by a minimum of discomfort. In edema with pus formation, it was found that the drainage of pus was automatic. In suture cases, accompanied by edema, a painful tension was placed on the sutures, sometimes necessitating their removal. The molding action of the tongue, lips and cheeks aids in the closure of the wound.

This open technic method of minor oral surgery which does not interfere with the blood supply and does not require suturing will bring its own reward in quicker healing, greater comfort and almost a total elimination of the so-called "dry socket."

1419 Washington Avenue.

THE JOURNAL *of the*
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RESPONSIBILITY FOR DIAGNOSIS

THE cardinal principle of the successful treatment of disease is an accurate knowledge of the cause and nature of the particular disease on the part of the one who undertakes to treat it, and the practitioner of any phase of the healing art is definitely obligated morally and legally to exert every effort in the application of all the knowledge gained in his professional education and later experience to arrive at a correct diagnosis of any and every ill that he undertakes to cure.

The moral obligation is embodied in the mental processes that have led to the desire to pursue a humane calling; the legal obligation is embodied in the delegation of the care and treatment of the sick to the professions of the healing art by the judiciary and health departments of the state and federal governments. The diploma which is received by the diplomate is awarded by an institution legalized by the state to conduct the educational program essential to the preparation of the matriculant for the practice of the healing art, and, by virtue of the obligation thus imposed upon the educational institution, the state and the federal governments delegate to the legalized practitioner all the rights, privileges and perquisites of such practice. The essence of the legal and moral

obligation thus assumed is the duty of the diplomate first to possess and exercise the necessary diagnostic skill which will enable him to arrive at a sound premise upon which to apply the principles of disease treatment.

Fortunately, however, the legal obligation calls for only the degree of skill commonly exercised in the community where the dentist practices, and does not demand an absolutely accurate diagnosis in every case, for the reason that there are still quite a number of diseases whose etiology is still unsolved; in the field of dental disease, for instance, dental caries, that paradoxical reason for and nemesis of dental practice.

The dental profession has been slow in recognizing the value of case reports, examinations and statistical studies of dental disease as bases of accurate diagnosis. It has also apparently overlooked the value of having records and data available to the health and welfare organizations and to the public.

Only recently have we been impressed with the importance of accurate records, based upon intelligent mouth examination, in the identification of criminals and lost persons. This means of identification through dental records has opened another avenue by which the dental profession can render a service to the judicial state departments and one that will tend to enhance the appreciation of the broadness of dental service on the part of the government and the public.

Case records predicated on careful, intelligent examination have been the foundation of clinical medicine, and such records can be of comparable value in dental practice. Unfortunately, however, the dental practitioner, in many instances, has failed to take advantage of the benefits of carefully kept case records and has thus handicapped himself and the profession as a whole in the effort toward professional advancement. We have, for many years, endeavored to impress upon the average practitioner an appreciation of the diagnostic value of case records and, we believe, with some success. However, a much greater appreciation of a proper evaluation of this most helpful adjunct in the diagnosis and management of dental disease is desirable.

The accumulation of data and statistics in dental practice, a feature of dental health service that has only recently received any considerable degree of attention, is rapidly becoming a source of proof of the health value of dental service. There is a danger, however, that we trust will be avoided in the extensive accumulation of case histories and case records in dentistry, and one that has brought criticism on the medical profession, and that is the tendency, bred by familiarity with disease,

to treat patients as cases rather than as human individuals—a tendency which is fatal to proper estimation of the value of medical service by the individual.

Another serious obligation that we can discharge through accurate diagnosis predicated on intelligent examination is the aid that such procedures will afford as an adjunct to general medical diagnosis of diseases of the body in which the dental mechanism is involved. There are still medical practitioners who do not appreciate the benefits of dental cooperation, but, on the whole, the medical practitioner is eager and anxious to receive aid from any quarter, and abundant evidence is accumulating to convince the most incredulous that dentistry in its constantly broadening scope can be and is of most important significance in the diagnosis and treatment of numerous bodily ills.

The practices of medicine and dentistry are becoming more and more interdependent, and the medical or dental practitioner who ignores the help which cooperation offers is neglectful of his moral and legal obligation to the public to exercise the degree of skill in diagnosis and disease treatment expected and demanded of his profession.

A phase of dental practice in which the dental practitioner can increase not only his own diagnostic skill, but also his value in collaborative health efforts, is in the internship service which many hospitals and health institutions are offering to the dental graduate. In this service as a whole, the dental intern has amply proved his ability to assume his share of actual oral surgical responsibility, and he has also proved beyond question the claim long made in dental circles that dental care in the hospital is an important and indispensable aid in the control of systemic disease and in promoting more rapid recovery of hospitalized patients.

It is quite likely that every dentist recognizes the desirability of correct diagnosis as a prerequisite to successful treatment of any disease, but it is quite unlikely that all dentists realize the obligation which the law places upon him to use every available means to that end.

All recognize that diagnosis is the key to proper treatment, that almost any physician or dentist is sufficiently familiar with pharmacology to apply the proper medication once he has correctly diagnosed a disease. In fact, this *sine qua non* to successful treatment of disease is recognized by the courts and is included in the qualifications required of those who presume to render health service; and, in the present state of development of dental practice, there is little excuse for failure to properly

diagnose the ordinary conditions continuously coming within the purview of the dentist. In fact, there are on record several cases in which the courts have held the dental practitioner legally responsible for correct diagnosis.

The broadening scope of dentistry, with its closer association with diseases that involve the general system, demands that the dentist keep well informed on these relations and equipped to do his part in collaborative diagnosis of oral conditions which express themselves systemically. And unless he is thus equipped, he is not qualified in the eyes of the law or in the eyes of the profession to practice dentistry according to the present-day conception of dental practice as a health service.

DENTAL CARIES

Findings and Conclusions on Its Causes and Control

Stated in 195 Summaries by Observers and Investigators in Twenty-Five Countries

Compiled for the Research Commission of the American Dental Association By *The Advisory Committee on Research in Dental Caries:* Daniel F. Lynch, *Chairman,* Charles F. Kettering, *Counselor,* William J. Gies, *Secretary.*

New York, 1939

THE compilation of the research work done on the subject of dental caries, in the effort to determine its etiology, comprises a monograph that presents in a condensed and digested form practically all of the published results of such research up to the present date.

Undertaken by the Research Commission of the American Dental Association, the work of collecting, compiling, condensing, analyzing and digesting the contributions of the various researchers and investigators was delegated to the above committee appointed by the Research Commission and we unhesitatingly designate the project as a herculean task accomplished in a most praiseworthy manner.

The problem of the etiology of dental caries is one that has from its inception confounded the students of dentistry, and this compilation of findings and conclusions may be the notable step that will prove to be the opening wedge to the solution of this most serious and important problem of the dental profession.

Numerous and varied theories advanced by numerous and varied authors and searchers are here presented, none of which, in the nature of the case, can be considered the final solution of the problem, but we are led to believe that here has been planted the seed that will bear the fruit of truth that we have long sought.

The organized profession is certainly indebted to the Commission and particularly to the Advisory Committee for the enormous amount of work and the sacrifice that such an effort entails.

The published monograph, comprising 188 pages, is now available and will soon be in the hands of every dental research worker in this and other countries.

Without attempting an interpretation and evaluation of the individual views and findings, the Committee has presented at the end of the volume a correlation and a general analysis of the findings and conclusions presented which should prove of material aid to those who continue the search as indicating the most valuable sources of collateral reference reading.

BIBLIOGRAPHICAL

Nutrition and Physical Degeneration.

By Weston A. Price, D.D.S., New York: Paul B. Hoeber, 1939. Price $5.

One of the outstanding books in dental literature in recent years, "Nutrition and Physical Degeneration" deals with the essential differences in the diets of the primitive races and those of the modernized groups. There is abundant proof that the aborigine degenerates as soon as he leaves his inimitable environment and assumes cultural patterns.

Dr. Price has written a dental textbook in the tempo of a travelog. In the first fifteen chapters, he introduces us to the isolated and modernized European, Indian, Melanesian, Polynesian, African and Australian aborigines. Then, in one of the most fascinating chapters, we are introduced to the early racial stock of the west coast of South America.

To describe each chapter in detail, giving proofs of dental degeneration, would be much like describing Grandmother's patchwork quilt. Grandmother was a master at weaving a story about each intricate patch. This is one of the most fascinating books presented in years for one who is interested in anthropology and archaeology. To those not interested in these subjects, Dr. Price's innumerable details may be tedious. Few persons could visit the places that Dr. Price has and come back with such a fund of knowledge and such excellent pictures of his subjects. This book is apparently a lifetime work.

In the later chapters, Dr. Price writes of "primitive control of dental caries" and its practical application of primitive wisdom. He again brings up the old subject of soil depletion and plant and animal deterioration; not only skeletal defects, but also physical and mental deterioration.

Every dentist should read this book. It may leave him, as it left me, feeling even more confused as to the proper approach in answering our patients when they demand to know why there is a continuance of dental caries. But at least the book gives us a viewpoint that is not generally found in the literature, and it will certainly make any man more humble when he attempts to attack the problem.

Career as a Dental Hygienist.

Published by the Institute for Research, 537 South Dearborn St., Chicago. Price 75 cents.

This small paper bound pamphlet, offered as one of a series by the Institute for Research, an organization devoted to vocational research, completely summarizes the information available concerning the possibilities of a career as a dental hygienist, covering what the occupation includes, the types of positions available, the schools offering courses in

dental hygiene, with the tuitional fees and length of the course, the salary a graduate can expect and a summary of the state laws licensing dental hygienists. This booklet fills a real need for the dissemination of pertinent material regarding the dental hygienist and should be read by those considering dental hygiene as a life work.

Clinical Pathology and Treatment of the Dental Pulp and Periodontal Tissues. By Edgar D. Coolidge, B.S., M.S., D.D.S., Professor of Therapeutics, Preventive Dentistry and Oral Hygiene, Chicago College of Dental Surgery, School of Dentistry, Loyola University, Chicago, Ill.; formerly Professor of Materia Medica, Pharmacology and Therapeutics, School of Dentistry University of Illinois. 461 pages and 289 illustrations. Price $6.50. Philadelphia: Lea and Febiger, 1939.

Every one who knows Dr. Coolidge and knew that he was preparing a textbook on "Clinical Pathology and Treatment of the Dental Pulp and Periodontal Tissues" has anticipated that it would be an exceptional book. In reading the book, one can readily see that every sentence has its place. There is nothing superfluous, overemphasized or neglected. In spite of the natural difficulties attached to the presentation of this subject, the text reads easily; which of course is due to the author's many years of hard work as a research worker, a teacher and a practicing dentist.

The book is a very valuable contribution to dental literature. No one can afford to miss it, since it treats the most vital question of dentistry, the problem of the non-vital tooth. The men who believe in treating teeth with diseased pulps can gain information from an operator with many years of clinical experience and also an actual research worker who has fought a hard fight to attain his knowledge. Those who still believe that every pulpless tooth must be condemned should study this book to learn wherein they have been wrong. The careful discussion of indications and contraindications for pulp treatment should be known by heart before an attempt is made to treat a diseased pulp. Dr. Coolidge states: "The following factors should be considered in determining the course of treatment: 1. The general health and susceptibility of the patient to infection. 2. The value of the tooth to the patient and its value as a factor in the mechanical reconstruction of the natural or artificial denture. 3. The ability of the operator to carry out the treatment of the tooth to a successful completion. The final result must be inspected by the operator without prejudice, and the standard by which other professional confrères will measure his results must also be the standard followed by the operator himself."

The diagnosis of pulp conditions and the course of their treatment is classified and described very clearly and convincingly. The use of drugs and other means of treatment and sterilization of the infected pulp tissues and teeth is based on wide experience and sound conclusions.

Special attention should be given to the study of Chapter IX, dealing with "Healing and Repair after Pulp Removal and Root Canal Filling." The careful technic of treatment and root-canal filling should, of course, be followed in attempting to reproduce Dr. Coolidge's results.

The illustrations are well selected and conclusive.

The treatment of oral and dental hygiene is just as excellent. Gingivitis and Vincent's infection, and their causes and treatment, are clearly described. The functional changes and traumatic injuries of the periodontal membrane have received special attention. Different treatment procedures are discussed. While, in the first part of the book, no statements were found which were not based on histopathologic facts, and the conclusions drawn are immutable, there are a few statements in the second part which could be discussed.

The value of dividing the atrophy of the alveolar bone into horizontal and vertical (page 398) is very questionable as regards clinical diagnosis, prognosis or even treatment. Such a division is based entirely on topographic conditions and has nothing to do with the nature of the disease.

The statement "The pocket forms suddenly in the periodontal tissue, on the side of tension, when the periodontal fibers become stretched beyond their functional range" (page 401) is, of course, an explanation for a process which has not been explained heretofore, but there are no histopathologic, or even clinical, evidences to sup-

port it. There is much evidence that contradicts such an explanation.

While trauma and its consequences are clearly separated from conditions of the gingivae, a few sentences cloud the otherwise clear conception of the author. On page 396, he writes, "Occlusal disharmony is an important contributing factor in the degeneration of the gingival tissues." In the following sentences, the discussion shifts from the gingiva to the periodontal membrane. We know that the periodontal membrane might be very gravely injured from trauma, but the explanation is missing as to possible influence on the gingiva.

Attention is called to one more point in particular. On page 154, Dr. Coolidge states, "The washing of any wound with an antiseptic is beneficial, but to pack an antiseptic upon a wound surface and leave it several days may increase the inflammatory reaction, increase the exudate accumulating in the tissues and lower the vitality of the cells." If this is true for the pulp, as Dr. Coolidge says, why is it not true for the gum, where Dr. Coolidge finds it beneficial for a long period? On page 420, he says, "The dressing is packed into the interproximal space between the teeth, to which the dressing becomes firmly attached as it hardens. The dressing is left upon the teeth for a week. . . ." Frequent changing of the dressing in gum treatment has, in my experience, proved most beneficial.

Dr. Coolidge is to be most sincerely congratulated on a distinct achievement in writing this book.

BALINT ORBAN.

Accepted Dental Remedies 1939.

Containing a list of official drugs selected to promote a rational materia medica and descriptions of acceptable non-official articles. 1939. Council on Dental Therapeutics, American Dental Association, Chicago, Ill. Price $1.

THE main purpose of this book is to serve as a useful guide to the practicing dentist, in his choice of dental medicinals, and to students and teachers of materia medica and pharmacology.

There is much information contained in this, now standard, publication that can be very helpful to the dentist in the pharmacologic aspect of dental practice; information presented in a concise and readily accessible form that will save much search and reading of the general dental literature.

Index of the Periodical Dental Literature, 1936-1938.

Compiled by ARTHUR D. BLACK,* A.M., M.D., D.D.S., Sc.D. Chicago: American Dental Association, 1939. Price $7.50.

THE Index of the Dental Periodical Literature covering the period 1936-1938 has just come off the press. The present volume, the fifteenth to be published, completes the indexing of 100 years of dental periodical literature. It was in 1897 that Arthur D. Black, then a student in dental school, noted the difficulties presented by the lack of a dental index. For more than twenty years, or until November 1920, when the first volume of the Dental Index was published, the problem of indexing the dental literature received his constant consideration. The first volume to be published, covering the five year period 1911-1915, was in the process of preparation for eight years. Subsequently, the Indexes were published at intervals averaging less than two years. Little by little, the work of indexing the literature reached back to 1839 and forward to 1938, until the hundred year period was completed.

All of the fifteen volumes of the Index are of essentially the same style and content. Each Index includes a list of the journals which have been indexed. Each contains an author index which lists under the name of the author all articles by him, biographic sketches of him, obituary notices, etc. A large part of each Index consists of articles arranged according to the "Black Classification."

This will probably be the last volume using the "Black Classification," as, for a number of years, there has been evident a growing need for an index which would be less complicated and more nearly similar in style to other indexes of scientific literature. The promise has been made that, starting with 1939, the references will be arranged in a dictionary style. In the next Index, covering 1939-1941, all articles will be listed strictly alphabetically under author and subject headings.

There are few, if any, other professions whose book and periodical literature has

*Deceased.

been adequately indexed for anywhere near one hundred years. The dental profession may well be proud of having such an extensive and useful index, and the credit for this accomplishment belongs in large measure to Arthur Davenport Black, to whose memory this volume is dedicated.

Nutrition and Physical Fitness.

By L. Jean Bogert, Ph.D., formerly Instructor in Medicine, University of Chicago; Instructor in Experimental Medicine, Yale University; Research Chemist, Obstetrical Department, Henry Ford Hospital; Professor of Food Economics and Nutrition at the Kansas State Agricultural College. Third edition. Fully revised and reset. Philadelphia and London: W. B. Saunders Company, 1939. 602 pages; 75 illustrations. Price, cloth, $3.

It is impossible for the reviewer to present all the good features of this complete publication. Suffice it to mention only a few of the many excellent characteristics. Of the abundant new material which has been added in the present revision, particular mention should be made of the unusually extensive and careful checking of all tables and the altering of figures (including food costs) wherever necessary to conform to the latest and most reliable data available.

A valuable addition is the introductory chapter, "Concerning Foods and Foodstuffs," together with a new chapter on metabolism and ductless glands. Of special importance and practical application are Parts IV and V, on "Meal Planning," with emphasis on the influence education has in promoting interest in and appreciation of the importance of a balanced diet and proper health habits, "food fads and fancies" and diet for special conditions.

The chapter "Recent Trends in American Dietary Habits" is of particular interest to the dental profession. Here, Dr. Bogert lists five characteristics of our national diet (which are the effects of industrial civilization upon our food habits): 1. Cereals form a large bulk of the diet and most of these are consumed in the form of highly milled products. 2. Sugar forms a much larger proportion of the diet than previously. 3. More highly refined, canned and preserved foods are used. 4. Too prominent a place is given to muscle meats. 5. Dairy products, eggs, fruits and vegetables tend to be used less freely than formerly. Dr. Bogert says that, as a result of these deficiencies in the American diet, "we have constipation as the 'national complaint' and an increasing amount of rickets, poor bone development and tooth decay."

A textbook for practitioners of medicine and dentistry, as well as for students of nursing and home economics, this edition is an authoritative handbook along the lines of a general treatment of the broad field of nutrition, the physiologic viewpoint being apparent. The author has directed her book to the use of those with little or no knowledge of chemistry, but who desire knowledge of nutrition chiefly for its application to maintaining health. Hence, it is a mine of information; for it possesses a practical teaching approach for all classes of students who are made distinctly aware of how to use this new-found knowledge for better health. Dr. Bogert's discussions are accurate, direct and clear—masterfully covering valuable information on health and longevity. No medical or dental library can be considered complete without the third edition of this valuable book.

H. P.

Nitrous Oxide-Oxygen Anesthesia. McKesson-Clement Viewpoint and Technique.

By F. W. Clement, M.D., Director of Anesthesia at Flower Hospital, Lucas County Hospital, Toledo Dental Dispensary, Toledo, Ohio; Etc. Cloth, price $4. 274 pages; 70 illustrations. Philadelphia: Lea and Febiger, 1939.

This new book, written after the author's long association with the late E. I. McKesson, whose contributions on the use of nitrous oxide-oxygen anesthesia are well known, presents a complete account of the use of this anesthetic agent for all types of surgical cases. The volume is divided into six sections. The first two parts deal with theories of nitrous oxide-oxygen anesthesia, the chemistry of the gas, signs of anesthesia, premedication of the patient and the detailed technic of the administration of nitrous oxide-oxygen anesthesia. There follows a section on the use of special technic—as endotracheal methods—and a short description of the use of nitrous oxide-oxygen anesthesia in the surgical treatment of various

clinical entities. Following this is a chapter of twenty-eight pages on the use of nitrous oxide-oxygen anesthesia and analgesia in dentistry. The entire procedure of general anesthesia for the dental patient is briefly, but adequately discussed, beginning with evaluation of the patient, continuing with methods of premedication, preparation of the patient, administration of nitrous oxide-oxygen, and placing of mouth gags and mouth props and concluding with a discussion of the treatment of anesthetic emergencies. There is a short section on the use of analgesia in dental practice. The book is a complete compend of the practical uses to which nitrous oxide-oxygen can be put, and as such is heartily recommended to those using this anesthetic agent.

Untoward Effects of Nitrous Oxide Anesthesia with Particular Reference to Residual Neurologic and Psychiatric Manifestations.

By Cyril B. Courville, M.D., Professor of Neurology and Psychiatry, College of Medical Evangelists, Los Angeles, Calif.; with foreword by Yandell Henderson, Professor of Applied Physiology, Yale University, New Haven, Conn. Cloth, price $4.75. 175 pages with 54 illustrations. Mountain View, Calif.: Pacific Press Publishing Association, 1939.

While it is fairly well known and appreciated that occasionally, after nitrous oxide-oxygen anesthesia, there is evidence of severe damage of the central nervous system, this is the first monograph to appear on the subject collecting the reported medical literature and adding twenty-six of the author's cases. While some would attribute these serious sequelae to a specific toxic action of nitrous oxide, or perhaps an unusual sensitivity of the patient to this agent, it seems probable, from the evidence presented by the author, that these effects are associated with the production of asphyxia. It is well known that the central nervous system is very sensitive to alterations in oxygen content of blood, and Dr. Courville presents here, through his pathology studies, the effects of nitrous oxide anesthesia and anoxia on the cortical cells. Lesions similar to those found in human beings dying after nitrous oxide-oxygen anesthesia can be produced in animals by ligation of the vertebral and carotid arteries, by exposing the animal to the action of asphyxiant gases or by reducing the oxygen content of inspired air; in other words, any mechanism which will promote relative cerebral anoxemia. That this information should be of interest to dentists is indicated in that five of the twenty-six cases presented followed anesthesia for the extraction of teeth. This volume represents an effort to promote better understanding as to why certain anesthetic deaths occur and should be widely appreciated by those engaging in the practice of general anesthesia.

Clinical Operative Dentistry and Therapeutics.

By W. Clyde Davis, A.M., M.D., D.D.S., former Professor of Operative and Clinical Dentistry and Dean of the Faculty, The University of Nebraska, College of Dentistry. 1939. 364 pages; 280 illustrations. Price $5 postpaid. Published by the author, Lincoln, Nebr.

This textbook, written for college students and busy practitioners of dentistry, presents briefly some facts, principles and methods which, the author says, "have proved entirely successful by exhaustive laboratory experiments and years of clinical application." The subject matter (which is logically presented) is divided into three parts: Part I is for sophomore students while learning operative technic. Part II is for junior students in their early clinical practice. Part III is for senior students, first semester, who should review parts II and III during their last semester before graduation. Each chapter is divided into from twenty to fifty headed paragraphs, which makes convenient quizzing and reference. The author's careful observation and long experience in practice and in teaching have given him an opportunity to obtain much material with which to illustrate his text in an interesting manner.

Since Part I of this textbook has been written for sophomore students and Part II for junior students, the subject matter (which occupies the greater part of the book) is elementary. Some of the subjects discussed in Part I include: nomenclature, general considerations of cavity preparation, management of the different classes of cavities and management of abraded surfaces. In Part II, the different materials

used in the filling of cavities and the special preparations involved for each are discussed. In Part III is found a chapter on "Examination and Diagnosis." This, no doubt, is one of the most important chapters of the book. The author says that a complete and thorough oral examination should be given early, in the first contacts with the patient, and periodically thereafter, if the best service is to be rendered. After this, the author treats of the alleviation and prevention of dental pains, prophylaxis, periodontoclasia, treatment of hypersensitive dentin, protection of the vital pulp, pulp canal surgery and therapeutics, mechanics of pulp-canal filling and pulp-canal management. H. P.

Dental Careers: Opportunities in Dentistry and Dental Hygiene.

By Chase Going Woodhouse, a Kitson Careers Series Book. New York: Funk and Wagnalls Co. 201 pages. Cloth, 12mo. Price $1.50.

The choice of a suitable and profitable career in a field that is not too overcrowded these days presents a serious problem to many a young person. This new volume in the Kitson series should find a wide and immediate audience among those who are searching out the various possibilities in different lines of endeavor. It should also prove of enormous value to vocational counsellors, schools and libraries.

The Kitson Careers Series, edited by Dr. Harry Dexter Kitson, of Teachers' College, Columbia University, was designed to provide the latest, most authentic information about occupations and has filled a tremendous need in the field of vocational literature. The author of "Dental Careers" is director of the Institute of Women's Professional Relations and an authority on occupations. In this book, she presents an illuminating study of an interesting and remunerative profession as well as a definitely important field of social service.

"A hundred years ago," she says, "dentists pulled teeth, put in fillings, and made crude false teeth, properly so called. Any one who wished could call himself a dentist. There were no educational or licensing requirements. While there were men doing excellent work, there were more part-time dentists earning their main livelihood as goldsmiths, barbers and even as blacksmiths. Today, the picture is very different. Even within the past twenty-five years, the advances in dentistry have been remarkable. The dentist is no longer content with doing a repair job. Dentistry is an important health service. The dentist diagnoses, prescribes for and treats human ills centered in mouth conditions, acting upon a philosophy of prevention rather than on a philosophy of repair."

This book outlines exactly the sort of work which dentistry in all its branches includes. It tells of the preparatory work necessary to enter a school of dentistry, and lists the various recognized schools throughout the country, giving the entrance requirements of each. The courses themselves are described and evaluated and—of highest importance—the expenses involved in studying dentistry are thoroughly tabulated.

The chapters on obtaining a license and entering practice are unusually practical and valuable. The pros and cons of private, assistantship and institutional practice as a beginning are constructively presented. Every item of necessary office equipment is listed, together with figures on minimum and average costs.

Types of practice available in the dental profession, a carefully calculated estimate of potential earnings, number of dentists practicing at present, etc., provide a wealth of data not to be found in concise form elsewhere.

There is a section devoted to opportunities for women in dentistry as a field of endeavor. Dental hygiene is also considered as offering a broad scope for women as does the position of dental assistant. Everything one could wish to know about getting into either type of work is clearly and graphically presented.

Young men or young women who are now investigating potentialities that lie in various types of careers will do well to read this book. They might profitably consider a point which the author so forcefully emphasizes: "In its larger aspects, dentistry offers adventure; the excitement of working to split the veil of the unknown; it offers the greatest of human satisfactions, the opportunity of alleviating and eventually preventing human suffering."

COUNCIL ON DENTAL THERAPEUTICS

EFF-REMIN DENTIFRICE—NOT ACCEPTABLE FOR A.D.R.

Report of the Council on Dental Therapeutics of the American Dental Association, authorized for publication.

THE Council's report on Eff-Remin Dentifrice (Goodrich and Love) was submitted to the firm. In the Council's opinion, the firm's reply did not contain adequate evidence upon which a revision of the report might be made. Therefore, the original report is presented for the information of the dental profession. The Council has received sufficient requests for information on Eff-Remin Dentifrice (Goodrich and Love) to warrant this report.

According to an advertising circular distributed by the firm, in the promotion of this product, "It is highly recommended by eminent dental authorities for 'soft' teeth, to check decay, to reduce sensitivity, to control decalcification due to erosion or dental caries, to neutralize excess mouth acidity, and as a very satisfactory dental prophylactic." Eff-Remin is also said to be a "gum-stimulant." Apparently, no other claims are made.

In support of its claims, the firm provides reprints of or references to articles by G. Lind,[1] Charles F. Bodecker,[2, 3] Andresen[4] and Samuel Charles Miller.[5]

In its advertising literature, the firm states:

We prepare Andresen's Formula,—*Eff*ervescent *Remin*eralizing Dentifrice. . . . The preparation of Andresen's formula requires a high degree of technical knowledge and skill. . . . Andresen has suggested the following composition for the powder to be used for remineralization:

Tartaric acid.
Solution of gelatine 10 per cent.
Precipitated phosphate of Calcium.
Precipitated carbonate of Calcium.
Basic Carbonate of Magnesium.
Bicarbonate of Sodium.
Chloride of Sodium.
Corrigents of taste, ad libitum.
White, effervescing, mineralizing Anticarieticum.

Why the preparation of this product should require a high degree of skill is unknown. Bodecker[2] gave the quantitative formula for Andresen's Powder as follows:

Tartaric acid	448 grams
Solution of gelatine 10 per cent	50 grams
M. and ad.	
Precipitated phosphate of calcium	
Precipitated carbonate of calcium	
Basic carbonate of magnesium	
āā.	160 grams
M. sic and ad.	
Bicarbonate of sodium	560 grams
Chloride of sodium	160 grams
Corrigents of taste, ad libitum	
M., sic.	
White, effervescing, mineralizing Anticarieticum.	

One tenth of the above quantity is sufficient for the use of a single patient for three months.

It should be noted that the firm, in quoting the dental literature, apparently overlooked the following, in Bodecker's[3] article:

Such white opaque spots in the enamel develop as a result of an acid affecting the surface of the tooth. This happens only according to my observations to the teeth of

individuals who are in a poor state of health . . . I am however convinced that the treatment of white spots from the exterior is a mere makeshift. I believe that the natural process of furnishing the enamel with sufficient mineral matter is from the interior, i.e. by way of the pulp.

Apparently, many of the claims made by the firm involve the question of metabolism in the enamel. In this connection, the Council does not deem it necessary to discuss this highly controversial problem in detail. The enormous literature on this subject and other subjects growing out of it or related to it has been summarized by Chase.[6] On the basis of a critical examination of the literature, Chase came to these conclusions *inter alia:*

The enamel is neither metabolic nor vital in any sense of these terms.

The case for repair or recalcification of enamel by the saliva is not proved. The preponderance of evidence is against such a process.

The enamel is a lifeless, inert, mostly inorganic substance, subject to influence by only physical and chemical processes which are chiefly of a destructive nature, but may contribute minute amounts of inorganic increments.

Among others, Turner,[7] Williams,[8] Weber[9] and Ehrensperger[10] mention the severe limitations of artificial remineralization of partially decalcified enamel.

Kronfeld[11] writes:

Whether such superficially decalcified areas of the enamel can actually become recalcified is still under discussion. Some investigators claim that such a reparative calcification is possible (Pickerill, Head; Andresen's theory of remineralization of the enamel), while others deny this possibility, or at least do not consider recalcification of the enamel as proved (Weber). The author does not believe that an actual "remineralization" of such an early carious lesion is possible.

As far as the Council is aware, it has not been established that so-called soft teeth can be hardened by artificial means; e.g., by means of Andresen's powder; nor is it by any means clear that such "hardening" would be of definite importance as far as control of caries is concerned.

G. V. Black[12] long ago conducted a study of so-called hard and soft teeth. On the basis of his findings, Black concluded that differences between hard and soft teeth, as far as dental caries is concerned, are of no consequence.

Recently, Rosebury[13] wrote:

There is little evidence indeed, to support the widespread assumption that "soft" teeth are more subject to decay than "hard"; the former may decay more rapidly although even this is not certain; but the most perfect enamel is readily dissolved by acids.

As far as the Council is aware, it has not been shown that Andresen's powder will change the composition or the reaction of the saliva for a significant period of time after use. The term "excess mouth acidity" is misleading.

While it is claimed that Andresen's Powder is of value in the treatment of sensitive teeth, it apparently has not been shown that this product is more effective in this respect than simple substances used for the same purpose and described in official books.

The effectiveness and usefulness of Andresen's Powder as a "gum stimulant" are open to serious question. As far as the Council is aware, there is no good evidence that Andresen's Powder exerts a beneficial effect on the gums or as to what that "beneficial effect" may be.

Andresen's Powder may well be an effective dentifrice in that it may aid the brush in cleaning the teeth. But the therapeutic claims advanced for the product do not rest upon a sound basis of facts determined by objective methods and under properly controlled experimental conditions. Indeed, it would appear from an unbiased review of the literature that most of the claims advanced for this product are contrary to the findings and opinions of dental in-

vestigators. On this basis, it would appear that the claims advanced by Goodrich and Love are misleading. In the interests of truth and accuracy, the statement that "it is highly recommended by eminent dental authorities" might be changed to read "it has been recommended by eminent dental authorities, but its value has been denied by other equally eminent authorities and the evidence seems to be against its usefulness."

Eff-Remin Dentifrice (Goodrich and Love), which is alleged to be prepared according to the formula of Andresen, is marketed with highly exaggerated and misleading claims. It is therefore declared not acceptable for A. D. R.

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A copy of the rules that govern the Council in the consideration of articles will be sent on request.

Harold L. Hansen, *Secretary.*

PRELIMINARY REPORT ON MONŌCAINE HYDROCHLORIDE

In view of the many requests for information on monōcaine hydrochloride, and because of the claims now being made in its promotion to the profession and (unfortunately) to the laity, this brief report is presented for the information of the dental profession.

Monōcaine hydrochloride (mono isobutyl amino ethyl para amino benzoate hydrochloride), which was first prepared by Goldberg and Whitmore (*J. Am. Chem. Soc.,* 59:2280, 1937), has been the subject of several pharmacologic reports (Abramson, D. I., and Goldberg, S. G.: Local Anesthetic Actions of Two Esters of Mono Alkylated Amino Alcohols. *J. Pharm. & Exper. Ther.,* 62:69, January 1938) and clinical reports (Adams, F. R.: Pain Control in Dentistry. *J.A.D.A.,* 25:906, June 1938; Hyatt, I. T.: Preliminary Report on Monōcaine Hydrochloride. *Georgia D. J.,* 12:3, November 1938).

From these reports and from unpublished reports submitted on behalf of monōcaine hydrochloride, it may be deduced that the following properties can be ascribed to the compound:

1. With epinephrine, it produces anesthesia similar to that produced by

procaine hydrochloride with epinephrine.

2. It is more toxic gram for gram than is procaine hydrochloride.

3. It is a more potent local anesthetic than is procaine hydrochloride.

The following claims, among others, have been advanced for the product:

1. It is synergistic with epinephrine and is itself a vasoconstrictor.

2. Dose for dose in the clinical concentrations employed, it is less toxic than procaine hydrochloride, commonly employed in dentistry.

The Council has examined these claims, among others, and has concluded that the evidence available is not sufficient to substantiate them. The Council is not convinced that monocaine hydrochloride is to be preferred over procaine hydrochloride or that it is a safer local anesthetic.

Therefore, the Council has postponed further consideration of monocaine until such time as adequate evidence is at hand for the proper evaluation of this product.

FEDERAL TRADE COMMISSION STIPULATIONS

Lambert Pharmacal Company, St. Louis, manufacturer of "Listerine Antiseptic," has entered into a stipulation with the Federal Trade Commission to cease and desist from representing by direct statement or by inference that all dandruff is due to an infection with *Pityrosporum ovale* or any other organism; that dandruff necessarily is a germ disease; that the dandruff germ has been isolated or identified; that the presence of *Pityrosporum ovale* necessarily means dandruff or that with its destruction dandruff disappears; that dandruff is necessarily infectious, contagious or "catching" or is in all instances passed from one person to another, or that any one of the foregoing assertions has been proved by findings of scientists or otherwise, or is a "scientific fact" or a "fact definitely established by scientists."

It is also stipulated that the respondent desist from representing that the product either cures or permanently relieves dandruff; that the product "kills the dandruff germ," "attacks the cause of dandruff" or "gets at the cause" or "at the root of the trouble" or penetrates infected hair follicles or "annihilates" the dandruff germ; that the product frees the scalp and hair follicles of the parasite that saps their vitality or "spreads a germ-killing film over the scalp"; that the product has "marked curative properties due to certain ingredients in a unique combination shared by no other antiseptic"; that ordinary remedies "aren't even antiseptic," are "smelly," affect only surface symptoms or merely remove surface symptoms temporarily, or that competitive products are obviously inferior to "Listerine Antiseptic" as a remedy for dandruff—when such are not the facts. (Stipulation 2502) (August 3, 1939)

Miles Laboratories, Inc., Elkhart, Ind., entered into a stipulation with the Federal Trade Commission to discontinue misleading representations in the sale and distribution of "Alka-Seltzer."

The respondent company agreed to cease the use of advertising matter implying that colds, neuralgia, distress after meals and "common everyday ailments" result from excess acidity of the blood, an acid condition of the blood or a deficient alkaline reserve of the blood, and that the alkalinizing effect of "Alka-Seltzer," by correcting such acid condition or restoring the alkaline reserve, will be a proper treatment for the ailments mentioned.

The respondent further agreed to discontinue representations implying that headaches, upset stomach and aches and pains result from, or are associated with,

excess acidity of the blood, an acid condition of the blood or a deficiency in the alkaline reserve of the blood, except when the ailments mentioned may be shown by competent scientific evidence to be directly associated with such conditions of the blood, and, subject to this exception, to cease making representations implying that the taking of "Alka-Seltzer," by correcting the acid condition of the blood or restoring its alkaline reserve, will be a proper treatment for such ailments.

The respondent also stipulated that it would cease representing that other therapeutic effects of "Alka-Seltzer" exceed the recognized benefits to be derived from neutralization of hyperacidity of the gastric contents or the analgesic and other effects of sodium acetylsalicylate, together with the action of buffer salts. (Stipulation 2503) (August 6, 1939)

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

Dentifrices*

Sodium Metaphosphate (Insoluble) 93% and Tricalcium Phosphate (Victor) 7%-Pepsodent: A mixture of insoluble sodium metaphosphate (93%) and tricalcium phosphate (Victor) A.D.R. (7%), compounded by The Pepsodent Company.

ACTIONS AND USES: It has been suggested for use in dentifrices.

Manufactured by The Pepsodent Co., Chicago, Ill.

PHYSICAL PROPERTIES: Specific gravity, 2.5, as determined by displacement of xylene in a pycnometer of the Hubbard type.

PARTICLE SIZE: A typical particle size record of sodium metaphosphate (insoluble) 93% and tricalcium phosphate (Victor) 7%-Pepsodent selected as most efficient is as follows:

1 micron	4.54%
1-10 microns	38.44%
10-15 microns	21.33%
15-20 microns	12.39%
20-25 microns	14.90%
25-30 microns	5.13%
30-35 microns	2.34%
35-50 microns	0.93%

ABRASIVENESS AND SCRATCHING: The abrasiveness, as determined by measuring the weight loss of a copper strip which has been brushed with a heavy suspension of the material being tested under a set of standard conditions for 100,000 strokes of the machine (details filed with the Council), representing five and one-half hours' continuous polishing, is 6-7 mg.

Extracted human teeth were suitably prepared for micrometer measurement, then mechanically brushed for more than five hours with a heavy suspension of the polishing agent. Micrometer measurements then showed an average loss of 0.001 mm. Results of the same order were obtained when water alone was used. (Details filed with Council.)

CHEMICAL TEST: Sodium metaphosphate (insoluble) 93% and tricalcium phosphate (Victor) 7%-Pepsodent is a white, odorless and tasteless powder. It is practically insoluble in water and most mineral acids. A 25 per cent suspension of this polishing agent in water has a pH between 5.0 and 6.0. It is stable in air. When dried in an electric oven at 95-98° C. for 5 hours, it loses not more than 0.5 per cent of its weight.

Weigh a 3-gm. sample into a 100-cc. centrifuging bottle and add 75 cc. distilled water. Stir with a motor driven glass rod for five minutes. Centrifuge for ten minutes at 2,500 R.P.M. Pipet off 25 cc. of the supernatant liquid (a slight turbidity is permissible) into a tared vessel and evaporate to constant weight at 110° C. The residue should not exceed 0.03 gm. (water soluble portion).

A suspension of 2 gm. of sodium metaphosphate (insoluble) 93% and tricalcium phosphate (Victor) 7%-Pepsodent in 8 cc. of freshly boiled distilled water after standing for three hours to reach solubility equilibrium has a pH of from 5.5 to 6.5 (glass electrode).

No effervescence occurs on the addition of hydrochloric acid to a slurry of the salt (carbonate).

One gram of the polishing agent when dissolved by the aid of

*A.D.R. 1939, p. 108.

nitric acid shows no more chloride than corresponds to 0.2 cc. n/50 hydrochloric acid and 0.2 gm. shows no more sulfate than corresponds to 0.5 cc. n/50 sulfuric acid (U.S.P. XI, p. 471).

An aqueous solution of the salt meets the requirements of the test for arsenic (U.S.P. XI, p. 436).

Weigh out a sample of exactly 5,000 gm. into a 400-cc. beaker. Add 50 cc. of water, 15 ml. of concentrated nitric acid and 30 ml. of concentrated hydrochloric acid. Boil down to about 20 cc.; add 200 cc. of water and continue to boil until the solution becomes clear. Add a few drops of methyl red as indicator and 20 cc. 4 per cent ammonium oxalate solution. Then add filtered concentrated ammonium hydroxide slowly drop by drop until the solution is slightly alkaline. Stir the liquid and make barely pink with acetic acid. Allow the calcium oxalate to settle out for at least an hour. Filter through a Whatman No. 42 paper, into a 500-cc. volumetric flask, wash the precipitate with hot 0.25 per cent ammonium oxalate, ignite in a porcelain crucible at 900-1000° C. and weigh as calcium oxide. The weight of calcium oxide should be not less than 170 mg. nor more than 190 mg., which corresponds to not less than 6.5 per cent $Ca_3(PO_4)_2.H_2O$, nor more than 7.2 per cent $Ca_3(PO_4)_2.H_2O$.

Make up the filtrate from the calcium precipitation to the 500 cc. mark. Pipet out 50 cc. into an unscratched 250-cc. beaker and add 2 cc. of concentrated hydrochloric acid and 10 cc. of magnesia mixture (prepared as follows: Dissolve 50 gm. of magnesium chloride and 100 gm. of ammonium chloride in 500 cc. of water. Make the solution slightly ammoniacal and allow to stand overnight, then filter. Acidify the filtrate with hydrochloric acid and add 5 cc. concentrated hydrochloric acid in excess. Dilute to 1 liter.). Cool the solution in ice water. Add filtered concentrated ammonium hydroxide slowly, with stirring, adding 5-10 cc. in excess. Let the solution stand at least four hours. Filter through a Whatman No. 42 paper and wash with cold 1-20 ammonium hydroxide. Transfer the precipitate to a weighed porcelain crucible. Burn off the carbon at a moderate red heat, while keeping the crucible in a slanting position to allow free access of air. When the precipitate is nearly white, ignite for one hour at bright red heat (900-1000° C.). Cool and weigh as magnesium pyrophosphate. This should weigh not less than 0.550 gm. nor more than 0.580 gm., which is equivalent to not less than 70.5 per cent nor more than 74 per cent phosphorus pentoxide, corresponding to:

$(NaPO_3)_3$	93.5%-92.8%
$Ca_3(PO_4)_2.H_2O$	6.5%- 7.2%

Purified Sodium Alkyl Sulfate (Alkyl Sulfate)-Pepsodent: Alkyl sulfate (general formula, $ROSO_3H$) is prepared by sulfating the mixed higher alcohols resulting from the reduction of fatty acids of natural fatty oils (such as coconut oil). The resulting compounds are neutralized to form sodium salts (general formula, $ROSO_3Na$). The main ingredient of these alcohols is lauryl alcohol. Purified alkyl sulfate-Pepsodent is stated to differ from sodium alkyl sulfate of commerce in that it contains a lesser amount of sodium sulfate and has been empirically purified to remove substances of objectionable taste, but unknown composition.

The purified product has been designated Irium (registered trademark No. 358,579, July 19, 1938). The firm has agreed to gradually subordinate the name Irium to the more informative name sodium alkyl sulfate or alkyl sulfate, with a view to the abandonment of the name Irium within two years if the products still stand accepted.

PROPERTIES: Purified sodium alkyl sulfate-Pepsodent is soluble in distilled water to the extent of approximately 5 per cent and gives clear solutions in hard (calcium-containing) water. The homologous calcium salts are slowly precipitated from such solutions; which indicates that calcium lauryl sulfate is less soluble than sodium lauryl sulfate. Aqueous solutions of sodium alkyl sulfate-Pepsodent are neutral or slightly alkaline and show low surface tension and pronounced foaming properties. Purified sodium alkyl sulfate-Pepsodent has cleansing properties similar to those of soap.

TESTS: An aqueous solution (5 per cent) meets the requirements of the test for heavy metals (U.S.P. XI, p. 447).

An aqueous solution of the salt meets the requirements of the test for arsenic (U.S.P. XI, p. 436).

Weigh 5 gm. into a flask and add 25 cc. of anhydrous isopropyl ether (free from peroxides). Agitate for ten minutes with a mechanical stirrer and filter through a Soxhlet thimble. Wash out the flask with the smallest portion of fresh isopropyl ether and filter through the thimble. Evaporate the isopropyl ether solution at room temperature in a tared Petri dish to constant weight. The residue shall not exceed 0.025 gm. (unsulfated organic materials).

Allow the isopropyl ether held by the residue contained in the Soxhlet thimble to evaporate at a temperature not exceeding 50° C. Place the thimble in a Soxhlet apparatus and add denatured alcohol 2-B. Extract for two hours. Replace the alcoholic extract with a fresh portion of denatured alcohol 2-B and again extract for two hours. Combine the alcoholic extracts, remove the thimble and dry at a temperature of about 50° C. Leach the thimble with hot distilled water until the last washing shows no turbidity with barium chloride

(test solution). Add 10 cc. of 10 per cent barium chloride solution to the water solution, which precipitates the sulfate as $BaSO_4$. Filter through a tared Gooch crucible, wash with distilled water, dry, and ignite at 800-1000° C. to constant weight. The weight of the $BaSO_4$ × 0.61 equals the sodium sulfate in 5 gm. of purified sodium alkyl sulfate (Pepsodent), which should not exceed 0.5 gm.

ASSAY: To the combined alcoholic extracts from the Soxhlet apparatus, add a sufficient amount of water to make a total volume of 500 cc. Place 50 cc. of this solution in a flask (to be attached to a reflux condenser) and add 10 cc. 10 per cent barium chloride solution and evaporate off all the alcohol, replacing the loss in volume with distilled water. When all the alcohol is gone, add 25 cc. concentrated hydrochloric acid and reflux under a condenser for two hours. Neutralize the solution with sodium hydroxide and adjust the pH to approximately 6. Make up the total volume to 200 cc. with distilled water and filter through a tared Gooch crucible. Dry and ignite to constant weight at 800-1000° C. The weight of the barium sulfate × 1.27 = sodium alkyl sulfate and should not be less than 0.44 gm. of sodium alkyl sulfate.

PHARMACOLOGY: The pharmacologic properties of sodium alkyl sulfate have been studied by Kitchin and Graham (J.A.D.A., 24:736-755, May 1937), Tainter *et al.* (*J. D. Res.*, 18:81, February 1939; J.A.D.A., 26:1461, September 1939) and Hatton, Fosdick and Calasgra (*J. D. Res.*, to be published). There are also several unpublished reports on this material. While sodium alkyl sulfate is, in equal concentration, more irritating and more toxic systemically than soap, U.S.P., it is also a more active detergent and is, therefore, used in dentifrices in lower concentrations than is soap, U.S.P. The available evidence thus indicates that in concentrations effective in dentifrices, sodium alkyl sulfate is no more irritating or toxic than soap, U.S.P.

Whether similar conclusions may be valid for other soap-substitutes can be determined only on the basis of adequate evidence.

ACTIONS AND USES: Purified sodium alkyl sulfate (Pepsodent) has been suggested as a detergent for incorporation in dentifrices. It is compatible with hard water and may be used in slightly acid dentifrices, as well as in those with neutral or alkaline reactions.

U. S. Patent No. 2,054,742 (September 15, 1936), assigned to the Pepsodent Co. Trademark "Pepsodent" registration No. 110,079 (May 2, 1916); reissued May 2, 1936. Trademark "Irium" registration No. 358,579 (July 19, 1938).

Pepsodent (Brand) Tooth Paste.—Composition: Each hundred grams is stated to contain insoluble sodium metaphosphate, 55.13 gm.; tricalcium phosphate (Victor), 4.32 gm.; purified alkyl sulfate (Pepsodent), 0.31 gm.; gum tragacanth powdered, U.S.P., 1.84 gm.; sodium benzoate, U.S.P., 0.21 gm; trisodium phosphate, 0.04 gm.; soluble saccharin, U.S.P., 0.01 gm.; glycerin, U.S.P., 23.22 gm.; flavoring oils, 0.46 gm.; water, 14.46 gm.

ABRASIVENESS: 6-7 mg. on Pepsodent instrument (details filed with Council).

Manufactured and distributed by The Pepsodent Co., Chicago, Ill. U. S. Patent No. 2,019,142 (October 29, 1935); U. S. Patent No. 2,054,742 (September 15, 1936). Trademark "Pepsodent" Registration No. 110,079 (May 2, 1916); reissued May 2, 1936.

Pepsodent (Brand) Tooth Powder.—Composition: Each hundred grams is stated to contain insoluble sodium metaphosphate, 89.60 gm.; tricalcium phosphate (Victor), 7.00 gm.; purified alkyl sulfate (Pepsodent), 1.25 gm.; soluble saccharin, U.S.P., 0.15 gm.; flavoring agents, 2.00 gm.

ABRASIVENESS: 6-7 mg. on Pepsodent instrument (details filed with Council).

Manufactured and distributed by The Pepsodent Co., Chicago, Ill. U. S. Patent No. 2,019,142 (October, 1935); U. S. Patent No. 2,054,742 (September 15, 1936). U. S. trademark "Pepsodent" Registration No. 110,079 (May 2, 1916); reissued May 2, 1936.

Pepsodent (Brand) Liquid Dentifrice.—Composition: Each hundred grams is stated to contain flavoring oils, 0.826 gm.; chlorothymol (preservative), 0.010 gm.; saccharin, 0.030 gm.; borate buffer salts, 1.715 gm.; purified alkyl sulfate (Pepsodent), 1.000 gm.; glycerin, 10.000 gm.; gum tragacanth, 0.750 gm.; certified colors, 0.003 gm.; alcohol (94.9%), 24.299 gm.; water, 61.367 gm.

Manufactured and distributed by The Pepsodent Co., Chicago, Ill. U. S. Patent No. 2,054,742 (September 15, 1936). Trademark "Pepsodent" Registration No. 110,079 (May 2, 1916); reissued May 2, 1936.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information on the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

President's Message

THE CENTENNIAL OF AMERICAN DENTISTRY

MARCH 17, 18, 19 and 20, 1940, in the City of Baltimore, under the auspices of the American Dental Association, American dentistry will celebrate the centenary of its birth. This should prove to be an epoch-making event in its progress. Never in the life of any living member of the profession will there be an occasion of like importance. Already, plans are under way to make this a memorable affair. A program is being prepared that will be unique.

Sunday, March 17, the American Dental Association, in cooperation with the American Association of Dental Schools, the American College of Dentists, the International Association for Dental Research, the Omicron Kappa Upsilon and several other dental organizations, will present a program showing the steps by which dentistry in this country has advanced to its present high standing. These will be represented by organization, journalism, education and research.

In each of the several scientific sections to be held March 18, 19 and 20, three essayists, chosen for their known qualifications for the assignment, will present papers. Each has been selected as representative of the best in his field. Men of high distinction outside the profession will address the general assembly.

On two of the three evenings, a pageant depicting the history and progress of dentistry will be presented. The cast of more than two hundred will all be professionals. Rehearsals are now under way to make this an outstanding feature of the celebration.

Attendance at the meeting in Baltimore should be an unforgettable experience, one which no dentist interested in the history and progress of his profession can afford to miss.

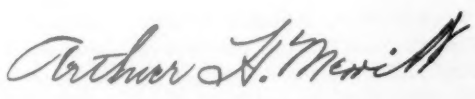
This centennial celebration has two main objectives, the first of which is to acquaint the members of the profession with the birth, development and progress of American dentistry. It is an inspiring record. Beginning as a mere craft, dentistry has, in the brief space of one hundred years, developed into a profession recognized throughout the civilized world for its excellence. It has made health service

its goal. It has transformed an occupation for livelihood into an occupation for service. To the world, it has given the greatest boon within the gift of man—surgical anesthesia. These facts should be reemphasized to the members of the profession for their inspiration and encouragement. In order that this may be done, plans are being considered for simultaneous celebration of our centenary by every dental society in the United States, possibly on February 1, the anniversary of the date on which the charter for the first dental school was granted. This will add greatly to the interest of the occasion and make possible the participation of those who may not be able to attend the celebration in Baltimore.

The second, and equally important objective, is to take advantage of the opportunity which the occasion offers to inform the public of what dentistry has achieved in the past, the service it is prepared to give in the present and its plans for the future.

In a word, this event should be made the occasion for widespread publicity. Never was there provided a better opportunity. It must not be allowed to go by default. To assure that it shall not, funds in considerable amounts will be required. With a view to paying some part of this cost, and at the same time giving greater publicity to the event, commemorative stamps will be sent to the members of the profession by the committee having the celebration in charge. Purchase these stamps when they arrive and affix them to your letters as you do the Relief stamps. Send in your dollar or as much as you can. The cost will be trifling as compared to the educational value of the plan.

Also publicize dentistry's centennial among your patients. Tell them of what American dentistry has accomplished in the first century of its existence. And lastly, make your plans now to attend the four-day celebration in Baltimore next March. With your cooperation—you who are one of the 45,000 who make up the membership of the American Dental Association—our centennial celebration can be made an unqualified success and a memorable event in the history of American dentistry. It needs only your cooperation to make it so.



ASSOCIATION ACTIVITIES

REPORT OF THE RESEARCH COMMISSION

(*Continued from October Issue, page* 1730)

ADVISORY COMMITTEE ON RESEARCH IN DENTAL CARIES

THE report for the Advisory Committee on Research in Dental Caries, a year ago, was presented as of July 8, 1938.

Since last July, we have sent by mail, to all known active workers and observers in the field of dental caries, copies of a second open letter, dated November 17, 1938, inviting the cooperation of all who had not responded to the first invitation dated April 18, 1938. (A copy is attached to this report.) During the past year, we also distributed, directly to these known workers and observers who had not replied, four circular reminders, on three of which were listed, cumulatively, the names of those who sent us summaries. (Copies of these reminders, dated July 28, 1938, September 15, 1938, October 4, 1938, and May 10, 1939, are attached to this report.) Various dental journals, in this country and abroad, published notices indicating the desirability of cooperative responses to our invitations. These conditions have brought 183 summaries of findings and conclusions from individual authors, or groups of authors, in twenty-five countries. A few additions are expected.

Each of the summaries in our compilation has been subjected, after thorough study, to the following editorial routine:

(1) Readjustment, including condensations in phraseology, and omission of repetitions and incidentals, intended to bring the main findings and conclusions to the fore, to facilitate direct comparisons among the summaries. Supporting details or subsidiary matters were assembled in an appended supplementary part, to be printed with type smaller than that to be used for the general portion.

(2) Presentation, to each author, of duplicate typewritten copies of his readjusted summary, for correction and further revision, and return of one copy for publication. (A copy of the circular explanation to the authors is attached to this report.)

This procedure (1-2) has been eminently successful and has been heartily approved by the authors. Of the summaries thus presented to 183 authors, all but nineteen have been returned, most of which are by authors in Australia, China, Korea, South Africa and several European countries. All will presumably be returned before the compilation goes to press. Reminders have been sent to all delinquent authors; but some have become refugees under present dictatorships, and our letters to these may not be delivered to them.

The individual summaries are now being copied in the alphabetic sequence of the names of the primary authors. This arrangement will enable readers to find any author's summary, in the book, as readily as they could locate a word in a dictionary.

A preface, a summary of the general conclusions stated by the authors of the summaries and a subject index are now being prepared. This work, and the whole manuscript, will be completed be-

fore the meeting of the Research Commission in Milwaukee next month.

WILLIAM J. GIES, *Secretary.*

RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION ADVISORY COMMITTEE ON RESEARCH IN DENTAL CARIES

SECOND OPEN LETTER TO ALL INVESTIGATORS, THROUGHOUT THE WORLD, IN THE FIELD OF DENTAL CARIES NOVEMBER 17, 1938

The American Dental Association, at its recent annual meeting in St. Louis, authorized the Research Commission to proceed with the publication, in book form, of the summaries of findings and conclusions on the cause and control of dental caries received, in response to our open letter dated April 18, 1938, from the 148 authors from the following countries: Australia, Austria, Canada, China, England, Finland, France, Germany, Italy, Java, Korea, New Zealand, Norway, Palestine, South Africa, Sweden, Switzerland and the United States.

We hope that all who wish to add findings and conclusions will present summaries before January 10, 1939, when the page forms for the book will be closed and the printing expedited. *The book will not be a review of published papers.* Instead, it will consist of the summaries of findings and conclusions that living authors currently regard as the *enduring results of their work and experience,* stated briefly, *in their own words,* for this compilation.

The summaries as presented will be supplemented by various devices intended to make each author's name and summary, each finding, each conclusion and each subject quickly and easily accessible to the reader.

This announcement is, in effect, also our *fourth reminder* to prospective collaborators who have not yet sent us responses, but from whom we hope to receive summaries, which may be sent to any of the addresses below.

FOR THE RESEARCH COMMISSION, BY THE ADVISORY COMMITTEE ON RESEARCH IN DENTAL CARIES:

DANIEL F. LYNCH, *Chairman,* 1149 16th St., N. W., Washington, D. C.

CHARLES F. KETTERING, *Counsellor,* General Motors Corporation, Detroit, Mich.

WILLIAM J. GIES, *Secretary,* 632 West 168th St., New York City.

MEMORANDUM FOR CONTRIBUTORS TO THE COMPILATION ON DENTAL CARIES

Herewith we send you duplicate copies of your summary, as readjusted:

(a) to place the main findings and conclusions first;

(b) to place supporting details second (to be in smaller type);

(c) condensed in phraseology to reduce both the time required in reading, and the space and cost in printing; and

(d) clarified, from the reader's standpoint, where uncertainty occurred.

We have endeavored to do this without changing the thought in any instance, and with intentional omissions only of repetitious or incidental matter.

Please regard the enclosures as the equivalent of a printer's proof, and *return one copy with your corrections, or confirmation as correct,* and with answers to any indicated questions or uncertainties. If there should not be time enough to send you a printer's proof, the copy (of the duplicates enclosed) that you return will be used in the correction of the final form for printing. If you make any revisions, to bring the summary up to date, insert on the returned copy the date that it should carry as of your latest revision. Summaries, from any who have failed heretofore to respond to our invitation to participate, may be added during this period of preparation of the manuscript for publication.

Please return one of the enclosed copies as soon as possible.

WILLIAM J. GIES, *Secretary.*

The work of the Advisory Committee on Research in Dental Caries has attracted world-wide attention, and the publication of the compilation is eagerly anticipated by not only research workers in the field but also the rank and file of practicing dentists. The Research Commission feels that the publication of this work will be an outstanding contribution from the American Dental Association to all dentists and will go far toward helping to solve a very common disease problem. The fine work of Dr. William J. Gies, Secretary of this Committee, should be singled out for special mention, and at this time the Research Commission wants to thank him for his untiring efforts in helping us to bring to a conclusion this very worthwhile project.

Respectfully submitted,

P. C. LOWERY, *Chairman.*

DANIEL F. LYNCH, *Secretary.*

Washington, D. C.

June 15, 1939

COMMITTEE ON LEGISLATION

POWER OF STATE TO REGULATE DENTAL ADVERTISING BY STATUTE

By LESLIE CHILDS, Indianapolis, Ind.

THE question of the power of a state to regulate dental advertising by statute has come up for consideration in court many times. Generally speaking, dental practice acts containing such provisions have been upheld by the courts as a valid exercise of the police power, though the holdings are not precisely in accord.

However, since each case has turned upon its facts in connection with the terms of the statute involved, such conflicts as appear in the holdings are perhaps more apparent than real; for running through the decisions is the thread of judicial intent to give effect to the legislative purpose when possible. For examples, let us review a few cases of this kind.

DENTAL ADVERTISING RESTRICTED

In Craven vs. Bierring, 222 Ia. 613, 269 N. W. 801, the validity of the advertising restrictions in the Iowa dental statute was up for consideration. The statute, so far as material here, forbids advertising, save as outlined, in the following language:

1. All advertising of any kind or character other than the carrying or publishing of a professional card or the display of a window or street sign at the licensee's place of business; which professional card or window or street sign shall display only the name, address, profession, office hours and telephone connections of the licensee.

2. Exploiting or advertising through the press, on the radio, or by the use of handbills, circulars or periodicals, other than professional cards stating only the name, address, profession, office hours and telephone connections of the licensee.

3. Employing or making use of advertising solicitors or publicity agents or soliciting employment personally or by representative.

Following the enactment of this statute, the plaintiff brought the instant action attacking it on constitutional grounds. The lower court dismissed the plaintiff's case. On appeal, the higher court, in reasoning on the validity of the statute

and in affirming the decree below, said:

THE LANGUAGE OF THE COURT

There is but one constitutional question of sufficient merit to warrant our serious consideration, namely, whether or not the limitations upon advertising are so arbitrary and unreasonable as to constitute an unlawful restraint and infringement and interference with the plaintiff's inherent right to carry on a lawful vocation.

We do not understand that appellant [plaintiff] questions the right of the state, under the police power, to reasonably regulate the practice of dentistry; but appellant strenuously contends that such legislation must bear a fair relation to the public health, morals, safety, or general welfare of the people, and he contends that, so long as there is nothing untruthful in the advertising matter, the public welfare is not affected adversely. . . .

The underlying purpose of legislation of this character is not especially aimed at the honest and honorable member of the profession who might be prone to use unethical means of calling attention to his superiority and indulge in what is referred to in some of the cases as "bait" advertising, truthful in itself. The object and aim of the statute is to strike at the charlatan and unscrupulous practitioner who makes use of the same or similar methods to entice and allure an unsuspecting and credulous public and by means of which they become victims of his quackery.

Obviously, no legislation can be upheld which would apply alone to the quack, but such legislation must be general in its application and rest alike upon all members of the profession concerned. . . . And, if legislation of this kind . . . becomes necessary to reach the unscrupulous in the interest of the public welfare—*and this is a matter for the legislature to determine*—the adoption by the Legislature of such rules and regulations does not invade or contravene the constitutional rights of the plaintiff. . . . We think the law bears a fair relation to matters of public health and the moral and physical welfare of the people. . . . The decree of the trial court is affirmed.

A like conclusion was reached in Semler vs. Oregon State Board of Dental Examiners *et al.*, 294 U. S. 608, 55 S. Ct. 570, 79 L. Ed. 1086. The case involved a construction of the Oregon statute which, among other things, prohibited the following classes of dental advertising:

Advertising professional superiority or the performance of professional services in a superior manner; advertising prices for professional services; advertising by means of large display, glaring light signs, or containing as a part thereof the representation of a tooth, teeth, bridgework or any portion of the human head; employing or making use of advertising solicitors or free public press agents; or advertising any free dental work or free examination; or advertising to guarantee any dental services or to perform any dental operation painlessly.

The plaintiff, a practicing dentist, challenged the validity of the above quoted provisions of the statute. The Oregon Supreme Court upheld the statute. The plaintiff appealed to the United States Supreme Court, and, in affirming the judgment of the state court, it was, in part, said:

WHAT THE COURT DECIDED

Recognizing state power as to such matters, appellant [plaintiff] insists that the statute in question goes too far because it prohibits advertising of the described character, although it may be truthful. He contends that the superiority he advertises exists in fact, that by his methods he is able to offer low prices and to render a beneficial public service contributing to the comfort and happiness of a large number of persons.

The state court defined the policy of the statute. The court said that while, in itself, there was nothing harmful in merely advertising prices for dental work or in displaying glaring signs illustrating teeth and bridgework, it could not be doubted that practitioners who were not willing to abide by the ethics of their profession often resorted to such advertising methods "to lure the credulous and ignorant members of the public to their offices for the purpose of fleecing them."

The legislature was aiming at "bait advertising." Inducing patronage by representations of painless dentistry, professional superiority, free examination and guaranteed

dental work is, as a general rule, the practice of the charlatan and the quack to entice the public.

It is no answer to say, as regards appellant's claim of right to advertise his "professional superiority" or his "performance of professional services in a superior manner," that he is telling the truth. In framing its policy, the legislature was not bound to provide for determination of the relative proficiency of particular practitioners.

The legislature was entitled to consider the general effects of the practice which it described, and if these effects were injurious in facilitating unwarranted and misleading claims, to counteract them by a general rule even though in particular instances there might be no actual deception or misstatement. . . . Judgment affirmed.

The foregoing cases constitute apt illustrations of judicial reasoning in upholding statutes that prohibit named classes of advertising, or which prohibit *all* classes not named. However, where statutes merely provide against "false" or "misleading" advertisements, or advertising that tends to "deceive" the public, we have a different situation. And here, to invoke the terms of the statute, it must, of course, appear that the advertising was "false" or "misleading," as the case may be. For illustration, let us examine State ex rel. Inscho vs. Missouri Dental Board, 339 Mo. 547, 98 S. W. (2d) 606.

FACTS IN THE CASE

Here, the Missouri statute provided, among other things, for the revocation of licenses for the following reasons:

2. The publication or circulation of any fraudulent or misleading statements as to the skill or method of any licensee or operator. . . .

The plaintiff was charged with violation of this statute, on the grounds of the character of his advertising. The latter gave the price of work, and then went into detail as to plaintiff's method of manufacture and fitting. At the trial, there was no evidence of untruth in any of plaintiff's advertising. The circuit court found for the plaintiff, and the higher court in affirming the judgment reasoned:

As we have pointed out, it was not charged nor was there any evidence whatsoever offered tending to show that any statement made in the advertisements was false or untrue or that [the plaintiff] did not, would not, or could not do the dental work described at the prices therein specified or that he did not use the materials or methods described . . . or that any misrepresentation was made in these advertisements about prices, materials, method or experience. . . .

As we have noted, the statute does not forbid advertising and unless there is a showing that the advertising is fraudulent and misleading . . . or that it tends to deceive or defraud the public, no cause for revocation is made out. . . . Apparently the statute was misconstrued. . . . It follows therefore that the judgment of the circuit court must be affirmed.

Of course, under statutes that merely forbid fraudulent or misleading advertising, the question of their violation will usually be one of fact. And, as an example of facts held to justify the revoking of a dentist's license under a statute of this character, Harris vs. State Board of Registration, 9 N. J. M. 635, 155 Atl. 258, comes to hand.

The New Jersey statute, under which the action arose, provided a number of grounds for revocation, among them being, to quote from the opinion:

. . . willful and gross malpractice and neglect in the practice of dentistry, and also the publication of grossly false, fraudulent, or misleading statements of one's art, skill, or knowledge.

The plaintiff's license was revoked for alleged violation of the foregoing statute. On appeal, the court, in reviewing the plaintiff's advertising activities, and in holding the evidence sufficient to justify the revocation of his license, among other things, had this to say:

[Plaintiff] employed an advertising agent, who wrote glowing copy and sent the same to the local papers. Although he had been

practicing dentistry only since June 20, 1926, the advertisements stated that his office had been conducted in New Jersey for fifteen years. . . . Below a woman's picture, the use of which was not authorized, the following unauthorized testimonial appeared:

"[Plaintiff] extracted seven teeth for me with sleep air, and I never felt a thing; then he made me a partial plate, and I must say it looks good and feels natural." Handbills were circulated containing another woman's picture, with remarks indicative that [plaintiff] had removed the wrinkles from the subject's face. . . . The writ [plaintiff's writ for review] will be dismissed, with costs.

CONCLUSION

In the light of the facts and holdings of the foregoing cases, the power of a state to regulate dental advertising by statute is no longer open to question. So too, the scope and extent of such restrictions rests solely within the sound discretion of the legislative branch of government.

The state may, in its discretion, prohibit specific classes of advertising, naming them; or it may prohibit all classes of advertising save specific kinds that are enumerated. And, by the great weight of authority, so long as the statutory restrictions apply to all dentists alike, they may not successfully be attacked upon constitutional grounds.

1520 East Tenth Street.

HEININGER APPEAL DENIED

THE United States Supreme Court, on October 9, 1939, refused to review the decision of the United States Court of Appeals for the District of Columbia which upheld the issuance of a fraud order denying to S. B. Heininger the right to use the mails for the purpose of selling dentures. This decision ends almost two years of litigation which began when the United States Post Office Department issued an order declaring that the selling of dentures by mail was fraudulent and that Heininger should be denied the use of the mails for carrying on this business.

Heininger then appealed the case to the United States District Court, which upheld his plea for an injunction against the enforcement of the fraud order.

From this decision, the Post Office authorities appealed to the Court of Appeals, which reversed the decision of the lower court and upheld the validity of the fraud order.

The refusal of the Supreme Court to review this decision of the Court of Appeals means that the fraud order has been declared valid by the highest authority, and that Heininger cannot continue to conduct a mail order denture business. There seems to be no reason to believe that Heininger's business was any different from that of a number of other concerns and it seems that all persons engaged in selling dentures by mail will be affected by this decision.

CHILDREN'S CLINIC AT TEMPLE UNIVERSITY ENLARGED

THROUGH the generosity of Mrs. Emilie Foster Klahr, of Philadelphia, enlargement of the Children's Dental Clinic in the Dental School of Temple University has been made possible.

The gift, announced recently by I. Norman Broomell, dean of the dental school, provides for the purchase and installation of a number of new chairs and operative units, which will result in an enlarged and more highly efficient department, operating as a distinct unit for

the treatment of the teeth of children.

The new equipment not only will enhance the interest of students in the subject of children's dentistry, but also will attract the interest of the little patients to be served. The new department will occupy the space which formerly housed the library on the first floor of the dental school building.

Mrs. Klahr is a friend of Dr. and Mrs. Theodore D. Casto, through whom the grant was made. Dr. Casto is professor of roentgenology and director of the department of pedodontology, which, since its inauguration in 1932, has made rapid progress under his supervision. The department, to be known as the "Klahr Children's Dental Clinic," will be open for ten months of the year, and will treat all dental defects, exclusive of orthodontia.

REPORT OF THE PROCESS PATENT COMMITTEE

TWO years ago, we reported to this body how we were able to stop a suit against one of our members on the Pacific coast by mere intimation that organized dentistry might enter the case. On the basis of that incident, we expressed the opinion, at that time, that we would probably never again have to go into court, because the Process Patent Committee would serve as a deterrent to those having patents on processes used in the practice of dentistry, but it seems that we were mistaken for now we come before you with a report on a process patent litigation in which our Committee was concerned during the past year.

The litigation resulted from a patent for the treatment of pyorrhea by means of an electric high frequency current which was issued to Dr. George Farrell Webb, of Kansas City, Mo., a member in good standing of the American Dental Association. The Webb patent embraces the following claims:

1. In a method of treating pyorrhea, the steps of successively subjecting small areas of unattached gingival margin to the action of a high frequency current.

2. In a method of treating pyorrhea, the steps of successively subjecting areas of unattached gingival margin smaller than the cross-sectional area of a tooth to coagulation by the passage of a high frequency current.

3. In a method of treating pyorrhea including the steps of subjecting predetermined small areas of unattached gingival margin and exposed necks of teeth to the action of a high frequency current.

4. In a method of treating pyorrhea including the steps of subjecting diseased gingival margin between two points spaced apart less than the diameter of a tooth to the action of a high frequency current.

The application of this current to human tissues has been common practice in physicians' offices for a long time, but the Patent Office examiner apparently believed that the use of high frequency current in the treatment of pyorrhea was novel and involved "invention" and that Dr. Webb was therefore entitled to a patent.

We may disagree with the examiner's conclusions, but apparently a well-known manufacturer of high frequency machines saw in the patent an opportunity for profit by making arrangements with Webb to attempt to limit his process to the purchasers of its machines. The result is that while a physician could treat the tongue or cheeks, and many diseases and conditions, with any make of apparatus that he chose, a dentist who used the same machine on the gum tissues in the treatment of pyorrhea would be-

come liable, under the patent, for damages and profits, as well as an injunction.

To the uninitiated, this might appear to be a machine patent which does not concern us, but actually the case is analogous to the Taggart inlay case. Taggart also tried to sell his casting apparatus, together with the right to use the process, but later when he could not find sufficient purchasers, he started suits for infringement. It seems that Webb intends to follow in Taggart's footsteps.

Dr. Webb filed suit in the United States District Court at Chicago against Dr. Arnold A. Frisch, who is a member of the Chicago Dental Society, for treating pyorrhea with a high frequency current machine which he had purchased from the Cameron Surgical Specialty Co. of Chicago, and also included the Cameron people in the suit as contributory infringers.

Unfortunately, neither Frisch nor Cameron knew about our Committee or that the American Dental Association was vitally interested in process patents. When we first heard about the matter, the evidence had already been presented, and it did not seem that there was much left for us to do, but upon discussing the case with the attorney for the defense, we found that he was not a specialist in patent law, that there were several points in the case which worried him, and therefore he would welcome the advice and assistance of some expert counsel in the field of patent law.

We immediately, therefore, communicated with the President, Dr. Ward, outlining the whole situation in detail, and upon receiving his unanimous approval of our decision that we would give the defense whatever assistance we could, we engaged the firm of Williams, Bradbury, McCaleb & Hinkle of Chicago, who had fought the Taggart inlay patents successfully. We are satisfied that the aid which they gave to the Cameron-Frisch attorney before the case was finally submitted was extremely valuable.

On May 20, 1939, the concluding arguments in the case were heard by Judge Barnes in the Federal District Court and he gave his decision immediately after the oral argument, briefs for both sides having been previously filed. The court decided that the Webb patent was invalid because other men had anticipated him by public use of the patented method. The evidence which saved the day for the profession was given by Drs. Walter C. Mayland, William J. Rennie, Theodore H. Perlman and William D. Olmstead, all of Chicago. We mention their names because we feel that their services to dentistry should be recorded. We may add that the Cameron Surgical Specialty Co. also deserves thanks, for although interested in defending themselves, they have also probably saved the profession a great deal of annoyance.

The indications are that the case will be carried to a higher court. We must, therefore, consider the following:

1. Should we contribute to the defense in the event of further proceedings in case of appeal, or stand by and merely await the outcome, and if the lower court is reversed, build up a new case of our own?

2. How shall we provide the necessary funds that will be required to carry on the defense?

3. What arrangement can be made whereby a quorum of our Committee shall reside within easy reach of Chicago, so that they may meet whenever matters of importance are to be decided?

4. Should men who are engaged in fighting against the welfare of the profession still retain their membership in the American Dental Association?

Respectfully submitted,

C. E. PETERSON,
C. W. MOSS,
L. W. JOHNSTON,
M. D. K. BREMNER, *Chairman.*

BUREAU OF PUBLIC RELATIONS

A LAYMAN PLEADS FOR MORE VITAL DENTAL HEALTH TEACHING

By ESTHER M. TRESS, Port Chester, N. Y.

TODAY, a sound knowledge of the effect of oral conditions on the general health is still confined to the dental profession and health workers. Unfortunately, the importance of preventive dentistry is not appreciated by the public. To fill this gap, schools must offer a program of dental health education to all students from the nursery school through high school. If we subscribe to the tenet that education is living—living to one's maximum ability—dental health education is of primary importance.

There are many dental problems of the layman which dental health education should help to solve.

FINDING A DENTIST

The majoriy of Americans could be called transients. Seldom do we find a community made up of families that date back several generations. With the constant change of residence, the family loses contact with a family physician or family dentist. In a strange community, the problem of choosing a dentist becomes acute, especially if a toothache develops. In a survey made not long ago in a town of 5,000, it was found that the school population changed 70 per cent in a period of five years. The children were asked how they happened to patronize their dentist. The findings were illuminating. The majority followed the recommendations of neighbors, relatives and friends. Some relied on the advice of policemen, druggists, insurance collectors or tradesmen. Not a small number used the classified telephone directory or followed a sign in a window. Certainly an unscientific method of finding a trained specialist. We laymen need help.

JUDGING A DENTIST

It is agreed that not all practicing dentists are equally competent. Could not criteria be set up by which a layman might be made aware of certain desirable practices of the good dentist? Does he wash his hands between patients? Is he clean about his office and person? Does he sterilize instruments? Is he interested in preventive dentistry? Is he interested in replacing missing teeth? Does he teach his patients how to care for their teeth? Does he interest them in dental nutrition?

If the layman were given an appreciation of dental training, the framed diplomas and degrees in a dentist's office would take on an added meaning.

INFECTIVE TEETH

The effect of oral infection on the general health of the body is not stressed sufficiently. As long as no pain accompanies a dental disease, too many Americans ignore the condition. A junior high school student asked permission to get a drink so often one morning that the teacher became concerned She found the child had two "gum boils," one of

which had broken and was discharging.

"Have your mother take you to the dentist this afternoon," advised the teacher.

"Oh, my mother says there is nothing to be done for gum boils," replied the child. "She had them when she was a girl and they went away after a while."

TOOTHBRUSHING

For years, toothbrushing has been a part of the incidental health teaching concurrent in schools. Although dental authorities are agreed on the correct method, few children are taught it; and the correct method being more difficult to acquire, the children adopt more simple procedures, harmful perhaps to the teeth and gums.

CONSUMER EDUCATION

It has been estimated that about $500,000,000 is spent annually in the United States on drugs for self-medication, some of questionable merit, like the mouth washes, and others of decidedly harmful nature. Too many home medicine cabinets are equipped with toothache drops and wax, some of which contain drugs which destroy the pulp, while others give a false sense of security resulting in delay in consulting a dentist. We can only meet the problem of self-treatment by intensive education which will help to build up a sense of judgment for weighing the claims of advertisers of tooth-related products.

LOSS OF PERMANENT TEETH

As an aid in the prevention of loss of teeth, faulty occlusion, change in facial expression, poor mastication, etc., it is of vital importance that people understand the need for tooth replacement. A dentist can recommend that a tooth be replaced, but the individual needs education in order to so appreciate the importance of tooth replacement that he will return to have the work done.

RECOGNIZING PERMANENT TEETH

Many parents, seeing a cavity in a first permanent molar and mistaking it for a deciduous tooth, make no effort to seek dental aid. Long Beach, N. Y., in its dental education program, stresses the care of the first permanent molar. It has been found over a five-year period that the percentage loss of permanent teeth was lowered from 28 to 3 per cent in the school population.

NUTRITION

It is common knowledge that the average American diet is not high in the protective foods necessary for dental nutrition. However, by instruction in food selection, one can be taught to eat more scientifically and so enjoy better health and increased longevity.

GENERAL DENTAL KNOWLEDGE

Most of the layman's knowledge of tooth structure, dental decay, etc., is gleaned from advertisers' blurbs. The problem is certainly important enough to merit the educators' attention. An understanding of dental processes would greatly influence one's attitudes and practices regarding dental health.

In order to determine present-day knowledge of the fundamentals of dental health education, groups of high school students in the New York City area numbering more than 1,000 were tested with more than 100 questions. The scores ranged from 11 to 84, with a median of 56.

Such a diagnostic test is a simple and speedy means of finding the gaps in a student's information. With reliable reference material and methods, teachers of science and home economics could disseminate dental health knowledge to millions of students and thereby help raise the dental health status of the nation.

RELATIONSHIPS AND RESPONSIBILITIES OF THE AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS TO THE DENTAL PROFESSION

By R. C. Dalgleish, D.D.S., Salt Lake City, Utah

THE early practitioners of dentistry were the barber, blacksmith and traveling tinker, who practiced dentistry as a sideline to their respective trades. This continued until about 1839, when, by the process of evolution, men following the calling of dentistry realized the need of converting the craft into a profession. As the science of dentistry developed, physicians gladly delegated care of the mouth to the dentist. The only part of the oral cavity to which any importance was attached by physicians was the tongue, which they observed as an aid to diagnosis. In fact, physicians had so little contact with the dental profession through the earliest years of its existence that dentistry was practically divorced from the medical field. Left to its own resources, dental practice developed along purely technical lines not associated with the welfare of the body as a whole. The observations of Miller and Hunter resulted in startling revelations. Demonstration of the fact that oral sepsis played an important rôle in the causation of systemic disease changed the practice of dentistry from the pursuit of a mechanical trade or commercial enterprise to the rendering of an essential health service.

The sudden realization of dentistry's importance in its biologic relationship brought about a revision of the educational program. This was clearly revealed in the more comprehensively trained and more efficient product of the dental schools. The dentist whose ministrations were found to be directly associated with the welfare of the body as a whole, and who was skilled in the basic sciences, with an understanding of biologic relationships, became at once a most important factor in the treatment of disease. Further consideration indicated the necessity for many specialized services in this connection, to make more effective the service of the dentist in the treatment of abnormalities and disease as well as the replacement of lost organs in the mouth. Where the dentist had been almost entirely separated from the medical field, he became vitally important as a counsellor of health whose services were frequently indispensable in the treatment of disease. Once totally ignored by the medical profession, the dentist now occupies an enviable position in the health picture, commanding a position of such influence that he enjoys a comparative equality with the physician in the promotion and maintenance of health, a counsellor as well as a purveyor of devices.

In the prevention of disease, the mouth, as an ideal breeding place for bacteria and the portal of entry of many diseases, should receive adequate supervision and care. The ever-increasing number of dental defects and diseases, the failure of research to establish the cause, the failure of corrective procedures and recognition of the direct relationship of dental care to the welfare of the body established oral conditions as a health problem. Health is a state of being sound in body, mind and soul, free from defect, disease and infirmity. We have private health and public health, but private health is a matter

of public concern. It is a matter of public concern because the presence of one unhealthy individual in a group is a potential danger to the entire group. Public health concerns itself with the promotion of positive health and the prevention of disease.

The first duty of the dentist has always been attention to the dental needs of the individual patient; but we must go beyond the conception that the rendering of services is an individual benefaction, and realize that it is a public health measure, benefiting the whole community by raising the standards of living and by increasing health and happiness. Gradually, through evolution, the dental profession has been able to demonstrate in a practical manner the value of its service in maintaining health, and to prove the necessity of oral health as insurance against bodily disease.

Recognition of this relationship brought about dental representation on state boards of health. Many states, counties, cities and school districts set up dental health programs within their organizations. Leaders in the dental profession believe that improvement of public health through dental measures will increase the prestige and standing of the dental profession. When the rank and file of the dental profession so believe, more intensive dental health educational programs will be instituted by dental societies. The oral hygiene campaign, some years ago, was practically the first reaction of the profession to the realization that dental service is a health service and that it has an obligation to lend a hand in promoting the idea of prevention. Probably the true objective of the oral hygiene campaign was the adoption of such salutory oral practices as contribute to the health of the community. With the realization of this positive objective, the profession gradually became aware of the necessity of broadening its horizon and increasing its scope beyond mere operative procedures in the mouth. The dental profession cannot function as a true health profession until progress has been made toward the prevention of disease. Until we know the factors in tooth decay, the most effective preventive program is early and regular care of the child. The improvement of dental health conditions depends on our ability to guide children in dental health practices.

It was realized suddenly that the problem was being attacked from the wrong angle, and we were blasted from the lethargic satisfaction of having made so many school examinations, showing so many defects per child, by school administrators, whose evaluation of our efforts in this connection caused us to reflect "Are we setting up as our goal of accomplishment a mere correction of defects, or should we aid in the building of better citizens, trained to assume the responsibility of maintaining themselves in a state of health?" Reflection produced a concept of responsibility, a greater interest in social problems.

With the rise to professional status, artisan accomplishment is being relegated to a position of secondary consideration in the profession's active interest in health problems of the community. Dentistry returns again to the mother profession of medicine in a spirit of willing cooperation, to share the responsibility of promoting positive health and preventing disease. Scientific research demonstrates that the most effective way to combat disease is to control it. We have seen the development of public health agencies to accomplish this. Dentistry and other health agencies began to direct their thoughts along similar lines with respect to general disease and its relationship to the general health picture. Possibilities could be seen. It became apparent that, in public health procedures, principally through education, there could be some hope of conquering, or at least materially reducing, dental disease and disorders.

The U. S. Public Health Service set up in its organization, as did some states, personnel to supervise dental health programs in their organizations. With crystallizing sentiment and continued activity of social groups, the Social Security Act was passed, enabling states through federal grants to enlarge their health programs with special emphasis on maternal and child health, dependent and crippled children, etc. The necessity of providing dental health supervision resulted in the profession's actively interesting itself in this new activity, and dental divisions were set up to direct dental health programs in a large majority of the states. A study of individual needs of states convinced those who were directing dental divisions that there was a need for correlating dental activity and harmonizing, to some extent at least, dental public health practice throughout the country. Thus, in a spirit of cooperation, the dental directors of state programs organized and chose to designate themselves as the American Association of Public Health Dentists.

Some apprehension has been felt by members of the profession as to the objectives and the motives of this group. Many, of course, could see in this latest creation the institution of socialized dentistry with the control of dental practice passing out of the hands of the dental profession. In a few instances, there was decided opposition. Fortunately, a sufficiently large percentage of the profession could see an opportunity for the profession in this new relationship; an opportunity to cooperate in the formation of a program strictly in harmony with their desires; an opportunity for dental health education that would be of great benefit to the people as well as the profession; an opportunity for important additional service; a recognition of their obligation to teach as well as perform; a recognition of the failure of corrective precedures to control the ever-increasing dental diseases and defects, a failure which has brought criticism on the profession for lack of knowledge of the cause of and control of dental caries and other diseases; a recognition of the fact that most of our efforts were directed along corrective lines, and very little along scientific and certainly more effective preventive lines; a recognition of a backward approach; a recognition of the ever-decreasing number of young men who are entering dental schools; a recognition that there was a lack of appreciation of the necessity and importance of dental care, and that too large a proportion of our population were not receiving care, and a recognition of the fact that people were, through cooperative effort, trying to provide themselves with care. For years, surveys of the medical facilities of the nation have been under close scrutiny, and social agencies have been agitating for extension of health service to all the people. This agitation, with the consequent opposition of the profession, has resolved itself largely into an attitude of cooperation wherein it is confidently hoped some plan may be perfected in which the present practice of the professions will not be materially interfered with and in which the professions may, through organized cooperative effort, help to determine the course and character of such extensions of health service.

Yes, these and many other facts suddenly brought the profession to the realization that here is an opportunity for dentistry to grow and fulfil an obligation heretofore neglected, the obligation to educate in matters pertaining to dental health. Within the dental profession, there has always been a small minority who have advocated programs conducted by the profession to educate the public. It was the activity of this group that promoted oral hygiene and public relations committee activity. Many state associations have well-rounded programs of educational activity.

The fact that men active in this work

were accused of mercenary interest in their educational activity kept this worthy undertaking submerged, but, as in health generally, dental health suddenly became a matter of public concern. Dentists reversed their positions to harmonize their opinions with the growing demand for greater dental health knowledge and service. The code of ethics remained as an excuse for some to refuse to lend cooperation to these progressive efforts. Many were emphatic in their criticisms of men who were giving their time generously and sincerely to further the public's understanding of dentistry and its relationship to health.

The addition of dentists to the public health service field raised a question of adapting newly acquired personnel to and harmonizing it with the field of public health. Some schools of public health recognized the need for training dental personnel in public health, and we now have several institutions which are offering to dentists certificates in public health for one academic year of resident instruction. In addition, several schools have included in their curricula short courses that may be taken during the summer or at other times when it is convenient for directors and others to leave their organizations for brief periods of instruction. There is only one alternative to public health training allowed directors of dental health divisions and that is the broad field of administrative experience. All others to be accepted must qualify by taking additional training as provided under the Social Security Act.

Thirty-five states have set up dental divisions either as separate divisions in the department of health or as subdivisions of some other major division in their respective organizations. Arguments are advanced in favor of each type of setup. However, it is my opinion (an opinion shared by many recognized leaders in the dental profession) that dentistry, recognized as the truly great scientific profession it is and occupying a position of great prominence in the health picture, is entitled to be represented in health departments, not only by membership on state boards of health, but also by its own individual dental division, administered by a qualified director who has been approved by the organized profession. This is a relationship and recognition in the field of public health that dentistry is entitled to. It must be said to the credit of the public health profession that the members have been most willing to cooperate, and have, for the most part at least, accepted dental public health procedures gladly. This relationship has developed more harmoniously in a few years than the public health relationship with the medical profession has in many, many years. Progress in dental public health has been possible because of the dental profession and not in spite of it. Surely public health organizations will do well to recognize this relationship of harmony, and accord dentistry the individual recognition it so justly deserves.

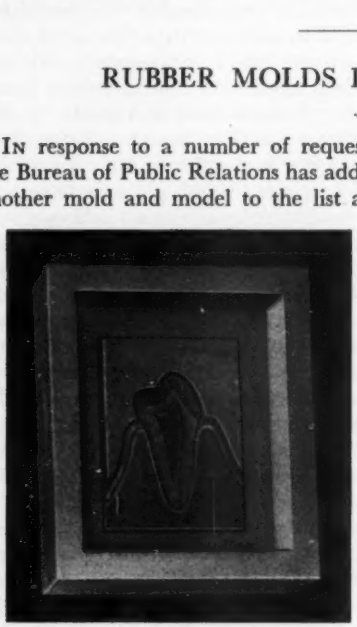
The American Association of Public Health Dentists is an organization of directors and assistant directors of dental divisions in state health departments and the U. S. Public Health Service. Its objects are to promote public dental health, maintain the ideals of organized dentistry in all public dental health projects and afford an opportunity for constructive discussion of the administrative problems of dental health programs. The first requisite to membership in this organization is membership in the American Dental Association. The organization maintains close affiliation with the American Dental Association. Though the members are members of the American Public Health Association and recognize the need for a close relationship with the American Public Health Association, because their problems are fundamentally dental and cooperation with the dental profession so harmonious and pleasant, and because of the

better opportunities for advancing the dental profession's interest in public health, they prefer to hold their annual meeting at the time of the meeting of the American Dental Association. Other organizations they desire to maintain close relationship with are the American Society for the Promotion of Dentistry for Children, the Educational Committee of the A.D.A., all other health professions and agencies and the National Educational Association. In fact, they desire to establish harmonious relationships with any legitimate organization or group that can assist in making the dental public health program more effective. It can be seen that the American Association of Public Health Dentists is justly proud of its parentage and, while hopeful of serving and cooperating with all public health agencies, has no intention of divorcing itself from dentistry.

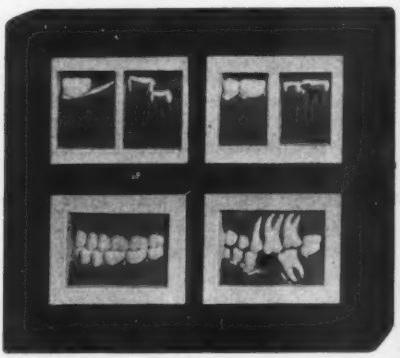
The organization keenly appreciates its obligation and the responsibility for maintaining the ideals of the organized profession, and, I feel sure, will bend every effort to assure dental health and preventive dentistry its rightful place in the field of public health.

RUBBER MOLDS FOR PLASTER MODELS

In response to a number of requests, the Bureau of Public Relations has added another mold and model to the list announced on page 1571 of the September Journal. It is planned to add additional molds and models each month until most of the more common dental conditions are reproduced. The rubber molds sell for 75 cents each. Attractive 2½ by 2 by ½ inch hand colored models sell for $1.25 each. The black imitation leather display case with transparent cover sells for $2. The display case plus four hand painted models sells for $6.50.



R-G. 2. Bicuspid rubber mold, 75 cents. Colored plaster model 2½ by 2 by ½ inch, $1.25.



Black imitation leather display case with transparent cover, $2; with four colored models, $6.50.

DENTISTRY AS A HEALTH SERVICE

In the office of Ozman J. Fusilier, of Dearborn, Mich., the following statement is prominently displayed:

In this office we attempt to render a health service. We do not sell gold, silver or teeth, and when we quote a fee it is not for the materials we use, but for the service we render.

We don't guarantee anything except that we will do our best to give a health service because we are dealing with living tissues and we cannot honestly guarantee that a filled tooth will not decay again or that the soft tissues of the mouth will not shrink under a denture any more than your physician can honestly guarantee that you will not catch another cold after he has helped you get rid of one.

How well work done in the mouth holds up depends on several things, some of the most important being your general health, which your physician can help you maintain, periodical checkup, prophylaxis and repair of your mouth by your dentist, your diet, habits and home care of the mouth, for which you are responsible.

The old idea of calling your physician when you have had a nervous breakdown or running to your dentist when you have a toothache is false, unsound and outmoded. The thing we stress in health service today is prevention, not cure. It is much wiser, healthier and more economical to keep the body well than to try to cure it after it is sick, and that is true of teeth, heart, kidneys, joints or any other part of our bodies. There is no cure so good as prevention.

SCIENTIFIC EXHIBIT OF AWARD AT MILWAUKEE

Part of Samuel Rabkin's exhibit showing variabilities in bone structure and their association with alveolar conditions. This exhibit won the first award, Division C, at the Milwaukee 1939 Session of the American Dental Association.

DENTAL ECONOMICS

COSTS OF DENTAL SERVICE FOR INDIGENT OR LOW INCOME GROUPS

By HARRY STRUSSER,* D.D.S., New York, N. Y.

IN the past few years, in fact since President Hoover's White House conference, dentistry has felt the lack of statistical and other data on the various phases of dental practice that might be obtained from studies and surveys of large groups of the population. Such data and statistics as we had led unmistakably to the conclusion that the most lasting and beneficial dental health service is that which is preventive and educational, and that, in order to obtain the best results, we should begin with the child at an early age.

Since the White House Conference, many studies and surveys of dental needs of children have been made and reported, the most conclusive of which was published in 1936 as Bulletin No. 226, United States Public Health Service, under the cooperative effort of the United States Public Health Service and the American Dental Association.

As was the case in the field of children's dentistry studies, there were only a few surveys and studies of large groups of adults available.[1] Therefore, the Committee on Economics, in 1937-1938, undertook a special study of the dental needs of groups of the adult population. The committee felt that while recommendations had been made for an extensive program of prevention, dental health education and research, the needs of the adult population should be carefully ascertained and preparatory steps should be taken to outline a program within the confines of the principles and recommendations approved by the House of Delegates and submitted by the special committee at the hearing on the National Health Act 1939, held June 1, at Washington, D. C.[2]

In November 1938, an opportunity presented itself to survey and study one phase of the dental relief program which is being carried on by the Works Progress Administration and sponsored by the Department of Welfare in New York City. The administrative and technical program of this project was reported to the Economics Committee at the St. Louis meeting. With the cooperation of the W.P.A. and the Department of Welfare authorities, I prepared a questionnaire for the purpose of securing data on 1,250 cases. These cases were taken from the files of the Heckscher, Harlem, Brooklyn, Queens and Bronx clinics. Each clinic reported on 250 patients, these reports to be known as Study B. The following information was sought:

1. Number of fillings needed.
2. Number of extractions needed.
3. Of the 250 patients, how many needed two dentures? It must be remembered that the dentures are given only for the following reasons in the order approved by the Dental Advisory Board.
   (a) Employability.
   (b) Boys for CC camps.
   (c) 60% masticating deficiency.

*Member of Committee on Economics.

TABLE 1.—SURVEY OF 1,250 CASES OF ADULT DENTAL PROJECT

TABLE 1.—SURVEY OF 1,250 CASES OF ADULT DENTAL PROJECT

Clinic	No. of Patients	Fillings	Extractions	Persons Needing 2 Dentures	Per Cent	Persons Needing 1 Denture	Per Cent	Persons Needing No Dentures	Per Cent	Percentage of Patients Needing Dentures	Total No. of Dentures
Queens	250	1,931	939	63	25	58	23	129	52	48	184
Brooklyn	250	331	1,001	174	70	49	19	27	11	89	397
Bronx	250	1,828	1,131	121	45	73	29	65	25	74	297
Harlem	250	1,075	1,238	150	60	44	18	56	22	78	344
Heckscher	250	1,419	914	99	40	77	31	74	29	71	275
	1,250	6,584	5,223	589	48	301	24	351	28	72	1,497
Total on basis of 1,000	1,000	5,267	4,178								

(d) Persons under 25 years of age.

4. Of this number (250), how many needed one denture?

5. Of this number (250), how many needed no dentures?

6. Percentage of patients needing dentures according to the rules adopted by the Dental Advisory Board of the Department of Welfare.

7. What is the total number of dentures needed?

Table 1 gives the replies to the questionnaire.

In such a study, the first thing to be considered is the source of the clientele served by these clinics. These patients are recipients of assistance from the Department of Welfare of New York City or employes of the W.P.A. earning less than $18 a week.

These data show that 1,250 cases needed 6,584 fillings and 5,223 extractions; or an average of 5.27 fillings and 4.18 extractions per person.

In a report in 1933 on 1,000 cases of white collar employes,[3] it was found that 1,000 persons needed 4,682 fillings and 1,139 extractions, or an average of 4.68 fillings and 1.14 extractions per person. A comparison of findings of studies A and B showed a marked variation in the number of teeth to be extracted, but a similarity in the number of fillings needed. At this time, a study to determine the cost of services was being considered and it was decided to include the features of the above mentioned reports, Studies A and B, in the proposed Study C.

In this survey (C), it was decided to obtain data on 1,000 completed cases, 200 cases from each of the clinics (Brooklyn, Bronx, Heckscher, Queens and Harlem).

The questionnaire was prepared and the data received were assembled as outlined in Table 2.

By reducing the figures of the study of 1,250 cases (Study B) to the basis of 1,000 cases and comparing them with the studies of dental needs of 1,000 cases (Study A) and the study of completed

service cases (Study C), the data in Tables 3 and 4 were obtained.

By averaging these figures, it is found that 4.79 fillings and 2.40 extractions per patient were needed.

A comparison of Groups B and C gives the data in Table 4.

Dentures were provided according to the rules of the Dental Advisory Board of the Department of Welfare. It is to be noted that there is a slight difference in the percentages obtained in Study C and those obtained in Study B.

Table 5, based on Study C (1,000 completed cases), presents further interesting figures.

Study C further reveals that 1,000 patients made 6,506 visits for complete operative service, while 1,000 patients made 3,338 visits for necessary prosthetic service; a total of 9,844 visits, or 9.85 visits per patient.

The average number of visits for operative work, for 1,000 patients, was 6.51, and 4.42 fillings and 1.90 extractions were needed. For prosthetic work only, 644 patients made 3,338 visits, or an average of 5.19 visits per patient, but the average number of visits for the prosthetic service for the whole group (1,000 patients) was 3.34.

Of the 644 who received dentures, 439 received two dentures and 205 received one denture; a total of 1,083 dentures. It will thus be seen that in 1,000 average patients, the denture requirement would be 1.08 per patient.

As I pointed out earlier, the authorities

TABLE 2.—PATIENTS RECEIVING DENTURES

Heckscher	Patients Receiving 2 Dentures					Patients Receiving 1 Denture					Patients Receiving No Dentures			
	No. of Fillings	No. of Extractions	No. of Visits for Operative Service	No. of Visits for Prosthetic Service	Total Visits	No. of Fillings	No. of Extractions	No. of Visits for Operative Service	No. of Visits for Prosthetic Service	Total Visits	No. of Fillings	No. of Extractions	No. of Visits for Operative Service	Total Visits
Case D3882	13	1	14	4	18									
E1029						1	0	2	5	7				
E4079											7	1	9	9

TABLE 3.—COMPARISON OF STUDIES A, B AND C

		Fillings	Extractions
Study A.	1,000 (1935)	4,682	1,139
Study B.	1,250 reduced to 1,000 for comparison (1938)	5,267	4,178
Study C.	1,000 completed cases (1939)	4,415	1,893
Total	3,250	14,364	7,210

were interested in the cost of this service, which should be considered as a "minimum adequate service" rather than complete adequate service. A large percentage of the patients, however, received "complete adequate service."

A study of the average cost of the clinic services was made for two months, per day, five days per week. At the time of the study, the dentists were paid at the rate of $1.52 per hour.

Figures were obtained for the average cost per denture, the average number of dentists' hours consumed and the number of visits made during these two months. It was found that it cost $6.97

TABLE 4.—COMPARISON OF GROUPS B AND C

	Needing Two Dentures Per Cent	Needing One Denture Per Cent	Needing No Dentures Per Cent
Study B	48.0	24.0	28.0
Study C	43.9	20.5	35.6

TABLE 5.—FINDINGS IN STUDY C

		No. of Cases	Fillings	Extractions	Operative Visits	Prosthetic Visits	Total Visits
Needing	Harlem	112	167	632	777	550	1327
	Queens	83	112	218	272	435	707
Two	Brooklyn	67	39	185	180	415	595
	Bronx	89	90	144	177	463	640
Dentures	Heckscher	88	100	113	251	444	695
		439	507	1,292	1,657	2,307	3,964
Needing	Harlem	24	153	72	277	103	380
	Queens	32	131	30	170	147	137
One	Brooklyn	72	142	208	315	428	743
	Bronx	36	91	43	128	163	291
Denture	Heckscher	41	130	9	196	190	386
		205	647	362	1,086	1,031	2,117
Needing	Harlem	64	683	45	904	—	—
	Queens	85	921	73	909	—	—
No	Brooklyn	61	378	64	467	—	—
	Bronx	75	731	56	834	—	—
Dentures	Heckscher	71	548	1	649	—	—
		356	3,261	239	3,763		3,763
	Total	1,000	4,415	1,893	6,506	3,338	9,844

December 1938 and January 1939. These two months were chosen because, during December, the clinics were operated on a thirty-hour-a-week schedule and in January they were operated on a forty-hour-a-week schedule. Each dentist operated four hours per day while the clinics were in operation on a schedule of eight hours

(average) per denture.* The average cost per visit excluding denture construction was $1.65. The average cost per hour was $3.49 (excluding dentures). The average cost per hour including dentures was $4.97.

*Commercial laboratories supplied the dentures on contract obtained by bid.

The average cost per patient, therefore, for dentists' services was $16.23 (9.84 visits at $1.65 each). The average cost per denture was $6.97. Therefore, the cost for a patient needing one denture was $23.20; for a patient needing two dentures, $30.17. The average cost per patient with or without dentures on a basis of 1,000 patients was $23.79.

On numerous occasions, I have been asked what the cost of this service would be if we paid the dentists on a basis of $5,000 a year. At the time of the study, as pointed out previously, the dentist received $1.52 an hour. Each dentist had an assistant and the clinic proper had a supervisor and the necessary clerical and janitorial and administrative staff to maintain operating efficiency. The only change in the cost of operation on the foregoing basis would be the cost of the professional service given by the dentists. As stated before, the dentists received $1.52 an hour. If the dentists were paid on the basis of $5,000 a year, they would then receive $3.33 an hour, or a difference of $1.81, with 1,500 hours a year as a basis.

From the figures submitted, it is evident that approximately 4.65 hours per patient is required, or 4.65 times $1.81, which is $8.42, added cost. I pointed out before that the cost per patient with or without dentures on the basis of 1,000 was $23.79 (average). If $8.42 for the extra dentist cost is added to this amount, the total is $32.21. This is far below the figure of Peter T. Swanish, who studied the reports submitted by the Chicago Dental Society. Dr. Swanish, in this study, based his findings on the average cost of a filling, an extraction, dentures, etc.; in other words, the cost of individual operations.

DISCUSSION

M. W. Prince: Was the service uniformly satisfactory?

Answer: It was checked by the supervisors and recently by members of the advisory board, who examined about 170 cases. In general, it was satisfactory.

E. H. Bruening: Do these people come back for reexamination after a certain period of time?

Answer: As a general rule, they do not, but we shall now attempt to study maintenance costs and are reexamining some of the patients now.

Dr. Bruening: I would like to have you describe a 60 per cent deficiency.

Answer: That has been gone into very carefully by the advisory board. The 60 per cent refers to a deficiency in mastication because of lack of opposing teeth, mainly posterior teeth, and occlusion. We give the minimum adequate service purely from the standpoint of rehabilitation or health service. It is not difficult to show by diagram exactly what the conditions are as we find them and the restoration made.

I. A. Epstein: How do you arrive at your percentage of deficiency? In Minnesota, we face the problem of having limited funds. We cannot take care of every one, and we wish to know where to draw the line. The Army, for instance, has very definite regulations regarding the number of teeth that must be missing before the applicant is considered as having a masticating deficiency.

Answer: The 60 per cent does not refer to the number of teeth missing, but to masticating deficiency. In the same way, the government determines the efficiency of the teeth of the Army and Navy applicants. The Army and Navy, in addition to consideration of the number of teeth, also demands certain teeth in opposition.

Dr. Prince: Where did you get the idea for this survey?

Answer: Last year when we discussed an adult survey in committee. I thought that here was an opportunity of obtaining statistical data for a group which would have to be cared for in any scheme or health program.

Dr. Prince: Mr. Chairman, I believe

Dr. Strusser's findings are one of the most significant things that have been brought to this committee. It seems to me that they might become a yardstick for the service given to those on relief elsewhere. Another question is whether this will tend to improve the general status of the profession.

Answer: I think it will improve it for the reason that we are dealing with the indigent. Let me show you what the private practitioner derives from our program. In the health department, we follow a program of dental education and prevention with the dental hygienist and the dentist. The competitive spirit is encouraged in the schools. Each class in school with 100 per cent good teeth prepares a program for the general assembly, the parents are invited and the class is presented with a banner. In January 1937, we had thirty-four classes with 100 per cent corrections of dental defects in the schools in which we are operating. We found that 58 per cent of the children attended the health department clinics and 42 per cent went to private offices. In June 1939, we had 206 classes with 100 per cent good teeth and 39.8 per cent went to the department of health clinics and 59.2 per cent to the private dental offices. The total registration in these classes was 6,896 children. The difference resulted from a health education and prevention program by an interested staff and a cooperative teaching group. We have changed the figures from 58 per cent going to the clinic to 59 per cent going to the private practitioner—a change of more than 20 per cent.

Eligibility for clinic service is based not only on the income of the person, but also on the amount of work to be done and the number of people in the family.

J. A. Sinclair: When such facts become widely known, will the majority of people begin to demand that the cost be brought much lower than it is in private practice today, and will that necessitate group practice on the part of the dentist?

Answer: Not as long as we have a definite eligibility level for the service. This problem of service for adults will gradually diminish as the preventive program for children is developed. Eventually, the restorative, ameliorative or rehabilitation programs will pass out of the picture and the order of the day will be prevention, education and research.

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ECONOMIC CONDITIONS IN DENTAL PRACTICE 1929-1937

THE United States Department of Commerce announces the release of the final results of a survey on the incomes of dentists made by Herman Lasken, National Income Section of the Department of Economic Research.

This survey, which was conducted with the assistance of members of the American Dental Association, presents the most recent and most comprehensive figures on dental incomes that are available. Copies can be obtained from the Department of Commerce; 10 cents each.

The Committee on Economics plans to present a digest of some of the information contained in this report in a future issue of THE JOURNAL.

ECONOMIC CONDITIONS IN THE DENTAL PROFESSION*

By HERMAN LASKEN, Washington, D. C.

THIS article presents the results of a nation-wide survey of economic conditions in the dental profession. A questionnaire was addressed to each member of the profession and usable returns were received from 6,295, or about one-seventh, of the members of the American Dental Association, and from 1,911, or about one-fifteenth, of the non-members.

The average net income from professional services, including professional salaries, of practicing dentists in the United States in 1937 was $2,914, or more than $55 a week. This level was one-third below the 1929 average of $4,275, but was substantially above the average of $2,251 for 1933. Trends for the non-salaried practitioners, who comprised about 93 per cent of all dentists submitting returns for the years studied, followed those of the entire profession very closely. While those dentists who were engaged partly in salaried work reported the highest average income in all the years studied, the extent to which their income position was more favorable varied substantially from year to year. Thus, their average income was almost $2,000 above that of the 100 per cent salaried dentists in 1929, but only slightly more than $200 higher in 1937. Although the average income of the 100 per cent salaried dentists was the lowest of the three groups in 1929, it exceeded that of the non-salaried practitioners in all of the other years under consideration by reason of greater stability. Specializing dentists showed average incomes which were relatively higher than those of general practitioners during all the years studied.

Approximately one dentist in seven reported an income below $1,000, or less than $20 a week, in 1937, and incomes below $2,000, or about $40 a week, were reported by much more than one-third of the practitioners. Almost two-fifths of the dentists reporting showed incomes of more than $3,000, and nearly one-seventh reported more than $5,000 in that year.

The proportion reporting incomes below $2,500 a year, or approximately $50 per week, increased from slightly more than one-fourth in 1929 to more than two-thirds in 1933, and then declined to about one-half in 1937.

Average incomes as related to years of practice in 1937 show a rapid increase during the early years, then level off to a maximum in the second decade of practice and decline slowly thereafter. The data indicate that during the period from about the seventh to the twenty-ninth year of practice, average incomes

*Extracts from an article by Herman Lasken, National Income Section, Division of Economic Research, Department of Commerce, Washington, D. C. Copies of the complete report can be obtained from the Department of Commerce for 10 cents each. Tables and charts presenting these figures in detail and additional data, including cross-tabulations of individual incomes of dentists over a period of years, comparisons of incomes with education, years of practice, size of place in which practice is located, type of practice and field of specialization, are included in the bulletin. Also included are figures relating costs of practice to gross income, and showing employment and pay rolls included in dentists' costs.

Methods of collecting the data, tabulation procedure and more precise definitions of the terms used in the survey are covered in the introduction of the bulletin. General conclusions are presented in the body of the article, and comparisons of incomes of members of the American Dental Association with incomes of non-members are included in an appendix.

exceed the average for the profession as a whole.

Lowest averages for the various groups shown were received consistently in communities of less than 1,000 population for all the years studied. The highest average was maintained in cities with populations of one million or more, with New York City ranking highest from 1929 through 1935, and Los Angeles for 1936 and 1937. The smallest relative declines in average income during the depression period were recorded in places of less than 25,000 population. Detroit reported the greatest relative decline from 1929 to 1933, but recovered substantially by 1937. Dentists in cities of 100,000 to 249,999 population reported relatively high incomes throughout, their average income ranking fourth in 1929, third in 1933 and second in all the subsequent years under consideration.

Highest average and median incomes were reported by dentists in the Pacific states. The Middle Atlantic group reported average incomes almost equal to those of the Pacific group, but their median income ranked fourth among the geographic divisions, indicating a high dispersion of individual incomes in that group of states. New England dentists ranked fourth in average income, but the more uniform distribution of incomes placed this region second in terms of median income reported. In substantiation of the findings with regard to size-of-place rankings, average incomes within the various regions tend to be highest in the states with the greatest proportion of urban population. Thus, Massachusetts had an average income higher than that of the other New England States, and New York and California each led their respective regions in average income received. The relatively low rankings of Philadelphia and Chicago are reflected in the low averages for the states of Pennsylvania and Illinois.

Independent practicing dentists retained 55 per cent of their gross incomes as net income in 1937, the remaining 45 per cent representing cost of practice. The effects of the relatively fixed costs of practice (such as office rent and depreciation on equipment) can be seen from the higher ratios of costs to gross income during the depression. While both net and gross income declined from 1929 to 1933, the percentage of gross expended for costs of practice increased from 40 to 46; which indicated that the total national outlay for dental services did not fall off so much during the depression as the decline in net income figures alone would indicate. Generally higher expenses entailed by the split interests of the part-salaried dentists are indicated for this group.

CURRENT LITERATURE

Potassium Changes in Submaxillary Glands During Stimulation

By J. H. Wills and W. O. Fenn

These workers have been able to show by analyses of submaxillary glands, electrically stimulated, that cats are able to replace completely the potassium lost in the saliva. Glands stimulated with pilocarpine, however, lost this restorative power as the output increased. This fact, that pilocarpine has some specific effect on the intake of potassium by the gland, they are unable to explain. The controls in the experiment were glands from the opposite side. It is to be noted in each case that the potassium in the saliva remained constant during the experiments, but, taking into consideration the rate of decrease under pilocarpine stimulation, the authors postulate that the gland probably would have ceased its production when the potassium was exhausted had the gland been stimulated longer.—*Am. J. Physiol.*, 124:72, October 1938.

Virgil D. Cheyne.

Cystic Hygroma of the Neck. Report of Twenty-Seven Cases

By R. E. Gross and C. F. Goeringer

Hygroma of the neck is uncommon. It is an endothelial lined, cystic lesion of lymphatic origin found most often in infancy and childhood. However, cases have been reported with initial development of symptoms in adult life. To date, approximately 225 cases have been reported. The authors report twenty-seven cases, with illustrations. The patients range in age from birth to 19 years.

The lesion, which is congenital, is presumably derived from rests of endothelial cells which are split off and isolated from the fetal lymphatic system, which arises from the primitive lymphatic buds of the neck.

In the average case, there may be no distressing symptoms other than the cosmetic disfigurement. The enlarging cyst may give rise to pressure on the trachea, pharynx or other structures of the neck. Frequently, the lesion will suppurate, especially during an attack of tonsillitis or other upper respiratory infection.

The hygromatous cyst is a soft, rounded or smoothly lobulated sac. Its walls are thin and translucent. The structure is usually monolocular, but quite often has side pockets separated by thin fibrous septa.

Microscopically, the fibrous wall is composed of connective tissue. Collagen may be abundant and compact, or scanty with a myxomatous appearance. A thin layer of flattened endothelial cells lines the cystic cavity.—*Surg. Gynec. & Obst.*, 69:48, July 1939.

J. Frank Hall.

Periadenitis Mucosa Necrotica Recurrens

By A. Fergusson

Periadenitis mucosa necrotica recurrens shows a predilection for the mucous membrane of the mouth. It occurs at all ages and seems to have a familial incidence. Small nodules develop on the oral mucous membrane. The lesion enlarges and becomes tender and, after about four days, sloughing begins. Healing takes place in from six to eight days with a soft grayish scar. Three theories have been suggested regarding the etiology of the condition: 1. It is associated with functional nervous disorders. 2. It is associated with thyroid dysfunction. 3. It may be of a paratuberculous nature. The treatment so far recorded has had little or no influence on the course of the disease. —*Brit. J. Derm. & Syph.*, 51:366, July 1939.

Joseph Volker.

Salivary Conditioning in Atropinized Dogs

By G. Finch

This work was undertaken to determine whether the conditioning process of salivary secretion in dogs could take place in the absence of the conditional response. Daily subcutaneous injections of 10 mg. of atropine sulfate (in two dogs) resulted in a pro-

gressive heightening of the preinjection parotid salivary secretion. Conditional salivary responses were not established in one atropinized dog during training when food was presented as the unconditional stimulus. This failure may be attributed to failure of the animal to ingest the food. Conditional salivary responses were readily established in two atropinized dogs on injection of dilute hydrochloric acid in the mouth as the unconditional stimulus. Conditioning thus established underwent experimental extinction and exhibited "spontaneous recovery."—*Am. J. Physiol.*, 124:136, October 1938.

VIRGIL D. CHEYNE.

Enzyme Action in the Digestive Canal. I. Enzyme in the Saliva of Human Subjects and Horses

By T. MATSUOKA

THE activity of amylase in human saliva was equivalent to one twenty-second of that of commercial diastase. There was no relation of sex and age to the activity of human saliva. The horse saliva contained a very slight amount of amylase, but the action was accelerated by the addition of bile.

II. Enzyme in Saliva of Various Animals

THE actions of amylase in saliva of cattle and the pig, goat and sheep were weak. A large amount of amylase was found in saliva of the guinea-pig and the rat. Dog and cat saliva contained a fairly large amount of amylase.—*J. Agr. Chem. Soc. Japan*, 13:865, 872, 1937; *Chem. Abstr.*, 32: 1286.

VIRGIL D. CHEYNE.

Some Properties of Salivary Enzymes

By F. KOPATSCHEK and S. VIDELA

PTYALIN is resistant to 0.076 per cent hydrochloric acid and 0.0977 per cent sulfuric acid. Concentrations of more than 0.15 per cent lead to its irreversible destruction, while intermediate acid concentrations lead to inactivation with partial restoration of activity after neutralization with sodium bicarbonate. Gastric juice does not interfere with the diastase action. Organic acids are innocuous at concentrations of 1 or 1.2; but the presence of lactic acid leads to inactivation at 2 per cent. The limit for alkalinity corresponds to 0.2 per cent sodium hydroxide. Ptyalin is inactivated at 60-65 per cent, but a small diastatic action persists at higher temperatures, probably owing to the presence of a diastase of pancreatic origin. The presence of mucin attenuates slightly the diastase activity.—*Rev. Sud-Am. Endocrinol. & Immunol. Quimioterap.*, 21:510, 1938; *Chem. Abstr.*, 32:9112.

VIRGIL D. CHEYNE.

Origin and Significance of Salivary Phosphatase

By G. E. GLOCK, M. M. MURRAY and PAUL PINCUS

DEMUTH in 1925 studied the occurrence of phosphatase in saliva. Since bacteria and desquamated epithelial cells have since been shown to be very high in phosphatase, the subject was reinvestigated by the authors. Tests were made on cell-free and bacteria-free saliva from cannulated ducts in human beings and in cats. Filtration methods were employed. In addition, several strains of bacteria were studied for phosphatase activity, which occurs constantly in saliva. Three esters were used as substrates; namely, Na-α, β-glycerophosphates and sodium phenylphosphate. From their results, the authors believe that salivas apparently have different degrees of phosphatase activity and occasionally none, but the subject is difficult of proof. The practical application of the investigation is that of the formation of deposits in the oral cavity of insoluble phosphates formed through the activity of the phosphatases splitting off phosphorus from soluble complexes and precipitation as the phosphate compounds.—*Biochem. J.*, 32:2096, December 1938.

VIRGIL D. CHEYNE.

Excretion of Ingested Ethyl Alcohol in Saliva

By T. E. FRIEDEMANN, W. G. MOTEL and H. NECHELES

THE usual method for determining the degree of intoxication has been to analyze the blood from the venous circulation. In this paper, the authors, using dogs and human beings, have determined that examination of the saliva affords as good an index to the amount of alcohol in the system as the

previous method. Urine specimens are of little use in such determinations. The alcoholic content of mixed saliva is attributed to a process of simple diffusion of the glands.—*J. Lab. & Clin. Med.*, 23:1007, July 1938.

VIRGIL D. CHEYNE.

Unification of Medical and Dental Education in the Basic Sciences

By L. C. FAIRBANK

WHILE American dentistry is unequaled in its mechanical and artistic achievements, it has yet to supply an effective way of providing satisfactory dental care for the people. Progress toward prevention has been retarded because the dental profession has failed to assume its biologic responsibilities and because the basic sciences have been inadequately integrated with clinical dentistry. There is a growing tendency to regard the profession as a trade and to look to the medical specialties for care of structures associated with the mouth. Medicine will be forced to become more active unless dental education is directed toward considerations of health and the control and elimination of the diseases of the mouth. Dentistry has not progressed because it has not recognized the advances made in the biologic sciences and has failed to develop a biologic concept of dental diseases. If dentistry is to become a highly specialized health service, there must be a unification of medical and dental thought. Toward this end, uniform scientific training is recommended for dentistry and medicine—*Mil. Surgeon*, 85:277, September 1939.

BASIL G. BIBBY.

Hyperparathyroidism in Children: Report of Two Cases

By W. ANSPACH and W. CLIFTON

THE authors present a report of two cases of hyperparathyroidism, complete with histories, laboratory findings and roentgenograms, extending over a period of two years, one in a child of 9 years, the other in an infant of 3 months.

The first case exemplifies the changes seen in adults and other children; i.e., generalized osteoporosis and metastatic calcification in the soft tissues. Removal of the parathyroid adenoma relieved the condition, and there was no recurrence during the subsequent three years.

In the second case, skeletal deformities and muscular weakness were most severe. Because of the hypercalcemia and hypophosphatemia, together with the initially normal renal function, it was believed this was a case of primary hyperparathyroidism, despite skeletal changes somewhat resembling those of renal rickets. The persistent loss of density of the endochondral bone noted on the roentgenograms leads to the belief that calcification as well as decalcification may be a feature of primary hyperparathyroidism during active growth. After roentgen irradiation of the neck, bones recalcified. Polyuria and hypotonia were relieved.

This is, according to the authors, the youngest patient reported on and the only one to show such spectacular recalcification on radiation therapy.

Nine plates and three tables are given. Excellent roentgenograms of progressive decalcification of the skull of the younger patient over a period of three years are shown. There are thirty-three references. —*Am. J. Dis. Child.*, 58, September 1939.

NORMAN S. SIMMONS.

Health Insurance: Impacted Wisdom Teeth Not a Disease. McGregor *vs.* General Accident & Life Assurance Corporation, N. C., 198 S. E. 641

A DEFENDANT insurance company, September 4, 1936, insured the plaintiff against "loss from disease contracted during the life of this policy and after it has been in continuous force for thirty days from its date." Within thirty days, the plaintiff's dentist informed her that she had four impacted wisdom teeth. These were extracted October 5th and the plaintiff was unable to work for five weeks thereafter.

The trial court entered a judgment in favor of the plaintiff, but, on appeal, the Supreme Court of North Carolina reversed the decision.

The sole question before the court was whether the disability of the plaintiff resulted from a disease or "a morbid condition of the body." The impactions had caused no pain or trouble prior to the extraction. In fact, the plaintiff was unaware of their presence. No morbid condition existed. The disability resulted from the ex-

tractions to which the plaintiff had voluntarily submitted.—*J.A.M.A.*, 133:1439, October 7, 1939.

MARTIN DEAKINS.

Approximation of the Calculated to the Determined Calcium Content of Human Dietaries

By A. GUTMAN and M. LOW

THE calcium content of sixteen low calcium diets and twelve intermediate and high calcium diets was determined by analysis. The results were compared with the dietary calcium content as computed by reference to tables giving mean calcium contents of the component foodstuffs. In twenty-two of twenty-eight observations, Sherman's revised (1937) tables gave better agreement between calculated and found values than did earlier figures. A disproportionate number of calculated estimates, however, whether based upon earlier or upon revised data, exceeded the determined values, the positive deviation being greater than 25 per cent of the calculated value in ten of sixteen low calcium diets.

The figures emphasize the hazards of employing calculated estimates of the calcium content of diets in conducting calcium balances for clinical or metabolic studies. —*J. Nutrition*, 18:257, September 1939.

NORMAN S. SIMMONS.

Studies on the Rôle of Bacteria in Tooth Destruction in Caries

By H. A. GINS

PREVIOUS bacteriologic studies of dental caries are considered to be deficient because insufficient attention is given to organisms which remain undisturbed on the tooth surface and because the anaerobic bacteria have not been studied. The action of anaerobic bacteria on the teeth was studied by placing sound and carious teeth in sterile sand which was kept moistened with sterile tap water. Several teeth were studied in this way. A sound deciduous tooth was not affected. Carious teeth observed over a nine-month period showed increases in the size of cavities and cavitation where enamel previously showed only the initial signs of caries. In one dry and sterile tooth, breakdown was initiated by the addition of material from a carious cavity. Several bacteriologic studies showed disappearance of the common bacterial flora after three or four months, bacilli of the mesenteric group being the only aerobes surviving. After six months, the anaerobes *Bacillus melinogenicum* and the leptothrix were present. It is concluded that caries must be considered a bacterial infection by anaerobic organisms, and it is suggested that the pathogenic flora of the mouth remain harmless as long as tissue resistance is high, but, when it is lowered, the anaerobic flora take on pathogenic properties, tooth destruction resulting. The author believes that the anaerobic organisms are important agents in caries in Germany, but that judgment should be suspended regarding their significance in other parts of the world. —*Zentralbl. f. Bakt. (Abt. 1)*, 144:54, 1939.

BASIL G. BIBBY.

Bacteriemia Following Tonsillectomy

By S. D. ELLIOT

BACTERIA were cultured from the blood stream immediately after thirty-eight of 100 tonsillectomies. This incidence of bacteriemia is almost the same as that following tooth extraction in clean mouths, but less than that caused by extractions from pyorrheic mouths (764). The organisms isolated from the blood were streptococci, pneumococci, staphylococci, influenza bacilli and diphtheria bacilli. A discussion of the occurrence of transient bacteriemia indicates that it occurs under a variety of conditions.—*Lancet*, 2:592, 1939.

BASIL G. BIBBY.

Evaluation of Neck Dissection in Carcinoma of the Lip

By G. TAYLOR and I. NATHANSON

STUDY is presented of 616 cases of carcinoma of the lip carried over nine years, of which 411 cases were submitted to neck dissection, the other 205 receiving local treatment or excision with no neck treatment. On the basis of the findings recorded in these cases, neck dissection is indicated in (1) cases with cervical lymph nodes larger than 1 cm. and (2) when a local process in the lip can be or has been cured.

If lymph nodes are less than 1 cm. wide, it is advisable not to operate, but rather to have an intense followup for three years after lip treatment.

The proper procedure in case neck dissection is necessary is: (a) biopsy; (b) dental clean up, extractions, treatment of pyorrhea;

(c) eradication of the local lesion by irradiation or operation; (d) reappraisal of nodes as to size, etc., after healing of wound; (e) neck dissection if necessary.—*Surg. Gynec. & Obst.*, 69:484, 1939.

ARTHUR F. FISHER.

Nasal Teeth—Report of a Case

By L. MARSHALL

APPROXIMATELY 100 cases of nasal teeth have been reported in the literature. The type of teeth found in the nose in the order of frequency are central incisors, cuspids, premolars and molars. About one-half of the teeth are supernumerary. Deciduous teeth are rarely found in the nose. The symptoms include: (1) unilateral obstruction of breathing, (2) chronic nasal discharge, (3) crusting and (4) localized ulceration. The treatment is surgical removal. In the case reported, a supernumerary cuspid was found in a 45-year-old man, who complained of severe epistaxis for a period of nine days previous to admittance. X-ray examination revealed the nasal condition. Removal was accomplished by a modified Denker radical antrum operation.—*Ann. Otol., Rhin. & Laryng.*, 48:775, September 1939.

JOSEPH VOLKER.

Anesthesia in Dental Surgery

By F. PRATT

THE majority of dental operations are performed on ambulant non-medicated patients. Ninety per cent of these are managed satisfactorily, but the remainder present problems in nitrous oxide anesthesia. Psychologic and physical factors affect the course of anesthesia. Nitrous oxide anesthesia is reinforced by the use of intravenous barbiturates or ethyl chloride. Cyanosis is considered unreliable as a sign of depth of anesthesia—*Brit. M. J.*, 2:555, 1939.

BASIL G. BIBBY.

Treatment of Fluoride Waters

By M. S. NICHOLS

IT has been clearly demonstrated that concentrations of one or more parts of fluorine per million in drinking water can produce mottling of tooth enamel. In addition, there is evidence that other structures in the body may be pathologically affected by abnormal intake of fluorides. Prevention of these abnormalities necessitates elimination of the substance from the drinking water. This may be accomplished by (1) sinking new wells in a different locality, as advised by a competent geologist; (2) developing available surface water supply low in fluoride and capable of treatment by ordinary purification methods, and (3) removing fluorides from the supply in use. Alum, activated alumina, lime at high pH values, tricalcium phosphate and magnesium hydroxide all have been shown to be effective in the last treatment.—*Am. J. Pub. Health*, 29:991, September 1939.

JOSEPH VOLKER.

Comparative Study of Innervation of the Gum

By D. STEWART and W. LEWINSKY

A COMPARATIVE study was made of the connective tissue of the gum underlying the epithelium with material taken from carnivores, rodents, insectivores and men. The fibers form superficial and deep plexuses, and leashes and specialized nerve-endings are also present. The types of specialized nerve endings seen have been: (1) coils which are situated in the intrapapillary zone or the deeper connective tissue, and (2) Ruffini-like nerve endings and convoluted fibers, the presence of which in the gum has not been previously described.—*Proc. Roy. Soc. Med.*, 32:1054, July 1939.

B. P. KEARNEY.

Silicosis Hazard in Mechanical Dentistry

By L. E. SILTZBACH

A CASE of silicotuberculosis in a dental mechanic who had been polishing dentures for nineteen years is presented.

Investigation showed that the laboratory which had employed him was using "pummy," an inexpensive substitute for pumice. "Pummy" contains a high percentage of free silica, capable of producing silicosis. The author reports that nowhere in the literature could the free silica content of pumice be found, but indications are that there is a wide variation.

The author advises discarding "pummy" and suggests the constant use of exhaust hoods. The question of the possible harmful effects of using pumice must await further chemical and clinical investigation. —*J.A.M.A.*, 113:1116, September 16, 1939.

B. P. KEARNEY.

INCIDENTS OF PRACTICE

Is Your Developing Solution Always Fresh?

A Procedure for Developing and Fixing an X-ray Film

By A. J. Crosta, D.D.S., Newark, N. J.

With the full realization that the scientific practice of dentistry is impossible without the use of roentgenography and that, in diagnosis, the x-rays are a factor of utmost importance, I am convinced that it is necessary to pay strict attention to all details from the time the patient presents himself for the taking of the roentgenograms until the developed film is dried and ready for interpretation.

However, so much literature is available as to the placing of the film, the angulation, time exposure, etc., that I shall confine myself to one phase of roentgenography; namely, the developing and fixing of an x-ray film, offering a method and formulas which I believe to be most practical, most economical and most nearly uniform in result.

I do not claim originality in this procedure, but having used the technic continuously over a period of three years, I am most enthusiastic as to its results.

Too frequently, x-ray films are of little or no value after development, not because no attention was paid to the angulation or to the time exposure, but because there was uncertainty regarding the strength of the developing solution.

It was this uncertainty which prompted me to seek a method of developing films in a solution the strength of which I knew to be uniform. Henceforth my motto shall be "Always develop in a freshly made solution."

Upon the surface, this statement may make the method appear impractical and expensive, but, on further study, it will be found to be quite simple and most economical.

On the assumption that all other details are strictly adhered to in the attainment of a useful roentgenogram, the details of developing and fixing an x-ray film are presented. The method used is the tray or visual method, employing the following formulas to make the developer, short bath and fixing bath.

PYRO-ELON DEVELOPER

No. 1
Elon, ¼ ounce
Sodium bisulfite, ¼ ounce
Pyrogallic acid, 1 ounce
Potassium bromide, 60 grains
Dissolve in 8 ounces of warm water
Add water to make 32 ounces

No. 2
Sodium sulfite, 5 ounces
Water to make 32 ounces

No. 3
Sodium carbonate, 2½ ounces
Water to make 32 ounces

These solutions are placed in three separate bottles or jugs (colored) and marked for identification.

SHORT BATH

Water, 32 ounces
Acetic acid 28 per cent, 1½ ounces

FIXING BATH

No. 1
Dissolve in 64 ounces of water, 1 pound of hyposulfite of soda.

No. 2
Dissolve in 5 ounces of warm water:
Sodium sulfite, 1 ounce
Acetic acid 28 per cent, 3 ounces
Potassium alum, 1 ounce

Add No. 1 to No. 2 and shake well.

THE PROCESSING

Place 7 ounces of tap water, the temperature of which has been determined, in an enamel-lined tray (6 by 9 inches) and add 1 ounce of each of Nos. 1, 2, 3 of the developer, and develop according to the Eastman Kodak standard time-temperature development chart. If developing more than

one film, keep tipping the tray so as to prevent the films sticking together. After development, wash the film off in clear running water, then dip it into the short bath just momentarily and place it in the "hypo" or fixing solution, allowing it to remain for at least ten minutes, then washing it in clear running water for at least fifteen minutes to be certain that all of the "hypo" has been removed.

The film is then hung up to dry, and we have a film from which an intelligent interpretation can be made and which can be filed away for an indefinite period without affecting its finish.

After the developing solution has been used, for one film or for a full-mouth series, the solution is discarded, and herein lies the importance of the processing of roentgenograms, and the vital point of this paper.

The quantity of the solution and the cost are so small that we need not hesitate to discard the used solution, which incidentally could not be used again because its developing strength has been weakened.

The short bath and the fixing solutions may be stored in separate compartments of the developing tanks, or in any other suitable container.

329 Roseville Avenue.

Resorption of Deciduous Roots

By M. Clark Green, D.D.S., Lynbrook, N. Y.

A girl, aged 12, presented herself for extraction of the lower left deciduous second molar, which was fairly loose and sensitive to the pressure of chewing. The tooth was badly decayed both mesially and distally.

On x-raying the area, it was noted that no permanent bud or tooth was present, and yet resorption of the roots of the deciduous molar had proceeded, as shown in the illustration.

All other permanent bicuspids were erupted and intact, and roentgenographing the full mouth revealed all of the permanent teeth including the second molars, which

were erupted intact. There is no history in the family of any similar condition.

CONCLUSIONS

1. This case and other similar cases observed in recent years seem to show that resorption of deciduous roots takes place owing to physiologic age conditions rather than the mechanical eruption of permanent teeth.

2. The case illustrates clearly the importance of examining all deciduous teeth roentgenographically before extraction no matter how loose the teeth are or whether corresponding permanent teeth are present in other areas of the mouth.

393 Sunrise Highway.

RESEARCH FELLOWSHIPS

Research Fellowships and Grants-in-Aid of the American College of Dentists

The American College of Dentists offers The William John Gies Research Fellowships and Grants-in-Aid for the purpose of assisting, especially citizens of the United States of America or Canada, in the prosecution of problems in dental research.

The Research Fellowships and Grants-in-Aid are intended principally for those who are in the early stages of preparation for their life work and who express the intention of pursuing a career in one of the preclinical sciences fundamental to dentistry as teachers and investigators in dental schools or other institutions, or those who desire to approach problems in clinical dentistry through a discipline in one of these sciences.

The Research Fellowships and Grants-in-Aid are not intended primarily for those already well established professionally, but

are designed to be of help particularly to young teachers and investigators with a dental degree who are in need of small financial subsidies to study laboratory or clinical research problems.

A study of problems of socio-economic importance to the dental profession may be supported either by the assignment of Research Fellowships or by Grants-in-Aid.

A Research Fellowship, based on a service period of ten months, shall carry with it a stipend of not more than $1,000 for a single person nor more than $1,200 for a married person.

The money appropriated for any Grant-in-Aid shall ordinarily not exceed $500.

Monies are appropriated as Grants-in-Aid for the purpose of providing special materials and equipment peculiar to the project which are not otherwise available.

The entire stipend of the Research Fellow is designed primarily to enable the recipient to conduct research in a well-equipped laboratory unless the Research Fellowship Board specifies that a certain part of it be expended to provide special materials or equipment.

Under exceptional conditions and at any time, the Research Fellowship Board may recommend the allocation of a sum not to exceed $100 to a worthy person engaged in research and whose financial condition warrants such action. The name of the recipient shall not be published and shall be known only to the Research Fellowship Board and to the Board of Regents.

All communications and requests for application blanks should be addressed to the chairman of the Committee on Dental Research of the American College of Dentists no later than December 1.

ALBERT L. MIDGLEY, D.M.D., Sc.D.,
Chairman,
1108 Union Trust Bldg.,
Providence, R. I.

DEATHS

Blackmore, Earl J., Hart, Mich.; Northwestern University Dental School, 1903; died July 31; aged 56.

Buck, Maurice A., Philadelphia, Pa.; Temple University School of Dentistry, 1908; died August 30; aged 54.

Buckley, Frank E., New York, N. Y.; New York College of Dentistry, 1897; died August 31.

Chadwick, Perley H., Rushville, Ind.; Indiana University School of Dentistry, 1899; died September 16; aged 71.

Cox, Charles M., York, Nebr.; University of Nebraska College of Dentistry, 1925; died May 12; aged 43.

Crooks, James B., Sewickley, Pa.; University of Pittsburgh, School of Dentistry, 1904; died August 28; aged 60.

Hunter, R. M., Huntingdon, Pa.; Temple University School of Dentistry, 1903; died September 18; aged 63.

Johnston, Andrew Peter, Omaha, Nebr.; Omaha Dental College, 1897; died July 9; aged 79.

Lawson, Raymond, Omaha, Nebr.; Omaha Dental College, 1904; died April 28; aged 59.

Lown, Rollo, Jackson, Mich.; School of Dentistry, University of Michigan, 1914; died August 17; aged 50.

McCracken, William H., Detroit, Mich.; School of Dentistry, University of Michigan, 1923; died September 12; aged 38.

Ronne, L. P., Lincoln, Nebr.; Omaha Dental College, 1905; died July 5.

Rosenberg, Joseph L., Chicago, Ill.; Chicago College of Dental Surgery, 1921; died September 18; aged 47.

Ruppert, L. L., Brooklyn, N. Y.; Temple University School of Dentistry, 1892; died August 24.

Spellman, B. L., Beatrice, Nebr.; Chicago College of Dental Surgery, 1898; died May 19.

Wolff, Charles, New York, N. Y.; New York College of Dentistry, 1914; died August 31.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, Ill., May 13-16, 1940.

AMERICAN DENTAL ASSOCIATION, Cleveland, Ohio, September 9-13, 1940.

CHICAGO DENTAL SOCIETY MIDWINTER MEETING, February 12-15, 1940.

DENTAL CENTENARY, Baltimore, Md., March 18-20, 1940.

DENTAL PROTECTIVE ASSOCIATION, Chicago, Ill., December 18.

DENVER (COLO.) DENTAL ASSOCIATION, Denver, January 7-10, 1940.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

FIVE STATE POST GRADUATE CLINIC, Washington, D. C., May 19-23, 1940.

GREAT LAKES ASSOCIATION OF ORTHODONTISTS, Dearborn, Mich., November 6-7.

GREATER NEW YORK DENTAL MEETING, New York City, December 4-8.

GREATER PHILADELPHIA ANNUAL MEETING, January 30-February 2, 1940.

INTERNATIONAL COLLEGE OF DENTISTS U.S.A. SECTION, New York City, December 3-4.

NATIONAL ASSOCIATION OF DENTAL ANESTHETISTS, New York City, November 27.

NATIONAL BOARD OF DENTAL EXAMINERS, December 4-5.

NORTH ATLANTIC ORTHODONTIC SOCIETY, New York City, November 15.

STATE SOCIETIES

November

Connecticut, at New Haven (15)
Ohio, at Columbus (6-8)
Puerto Rico, at Caguas City

February (1940)

Minnesota, at St. Paul (27-29)

April (1940)

Alabama, at Birmingham (9-11)
Kansas, at Kansas City, Mo. (28-May 1)
Louisiana, at Monroe (18-20)
Michigan, at Detroit (15-17)
Missouri, at Kansas City (28-May 1)
Texas, at Dallas (9-11)

May (1940)

Georgia, at Macon (14-16)
Indiana, at Indianapolis (20-22)
Montana, at Billings (2-4)
New York, at Buffalo (14-17)

June (1940)

Connecticut, at New London (5-7)

STATE BOARDS OF DENTAL EXAMINERS

California, in San Francisco, December 4. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, November 14-18. A. J. Cutting, Southington, Recorder.

Illinois, in Chicago, November 7-10. Homer J. Bird, Springfield, Superintendent of Registration.

Iowa, at Iowa City, December 11-15. Hardy F. Pool, Mason City, Secretary.

Minnesota, at Minneapolis, December 15-21. Paul Hagen, Crookston, Secretary.

New Jersey, December 11-16. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

Pennsylvania, in Philadelphia and Pittsburgh, December 5-9. Reuben E. V. Miller, 61 North Third St., Easton, Secretary.

Rhode Island, at Providence, December 12-14. Philip J. Conley, 2 Old Colony Bldg., West Warwick, Secretary.

Texas, at Houston, November 20-23. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Wisconsin, in Milwaukee, December 11-15. S. F. Donovan, Tomah, Secretary.

GEORGIA DENTAL ASSOCIATION

THE seventy-second annual meeting of the Georgia Dental Association will be held at

Macon, May 14-16, 1940, with headquarters at the Hotel Dempsey.

R. H. MURPHY, *Secretary,*
920 Ga. Cas. Bldg.,
Macon.

OHIO STATE DENTAL SOCIETY

THE seventy-fourth annual meeting of the Ohio State Dental Society will be held at the Neil House, Columbus, November 6-8. The first session of the House of Delegates will be held Sunday afternoon, November 5, at 2:30. A conference dinner of state and component society officers will be held the same day at 6:30 p.m. A three-day program will cover every phase of dental practice. All A.D.A. members are invited.

EDWARD C. MILLS, *Secretary,*
255 Broad St.,
Columbus.

MISSOURI-KANSAS BI-STATE DENTAL MEETING

THE Missouri-Kansas Bi-State Dental Meeting will be held in the Municipal Auditorium, Kansas City, Mo., April 28-May 1, 1940.

J. EMMETT NORTHCUTT, *President,*
Missouri State Dental Association,
1107 Bryant Bldg.,
Kansas City, Mo.

MONTANA STATE DENTAL ASSOCIATION

THE next meeting of the Montana State Dental Association will be held at Billings, May 2-4, 1940.

DENTAL SOCIETY OF THE STATE OF NEW YORK

THE next meeting of the Dental Society of the State of New York will be held at Buffalo, May 14-17, 1940.

REGISTRATION OF DENTAL LICENSES

EFFECTIVE September 19, 1939, Section 1650 of the Dental Practice Act of California was amended to read as follows:

1650. Every person who is now or hereafter licensed to practice dentistry in this state shall, prior to January 1, 1940, register, on forms prescribed by the board, his place of practice with the secretary of the state board of dental examiners, or, if he has more than one place of practice, all of said places of practice, or if he has no place of practice, to so notify the secretary of the board. A person licensed by the board after January 1, 1940, shall register with the secretary within thirty days after the date of his license.

Forms for registration of licenses have been already mailed and cooperation in this matter is earnestly requested.

Section 1651 was also amended, requiring any dentist and dental hygienist to register any change of address with the secretary of the Board of Dental Examiners of California within thirty days of such change.

It is now no longer necessary to register with the county clerk.

KENNETH I. NESBITT, *Secretary,*
Board of Dental Examiners of
California,
515 Van Ness Ave.,
San Francisco.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will hold its next examination November 14-18.

A. J. CUTTING, *Recorder,*
Southington.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Minnesota State Board of Dental Examiners will be held at the School of Dentistry, University of Minnesota, Minneapolis, December 15-21, for licenses to practice dentistry and dental hygiene. Minnesota now has reciprocity with North Dakota, South Dakota and Iowa. All applications must be filed with the secretary at least ten days prior to the opening date of the examination. Until further notice, address all communications regarding particulars to

PAUL HAGEN, *Secretary,*
Crookston.

DENTAL COUNCIL AND EXAMINING BOARD OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, December 5-9. For information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg, or

REUBEN E. V. MILLER, *Secretary,*
61 North Third St.,
Easton.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, December 4-5, in schools where there are five or more candidates. For information and applications, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

DENTAL CENTENARY CELEBRATION

THE one hundredth anniversary of the founding of professional dentistry will be celebrated in Baltimore, Md., March 18-20, 1940.

MEYER EGGNATZ, *Secretary,*
Medical Arts Bldg.,
Baltimore, Md.

DENTAL PROTECTIVE ASSOCIATION OF THE UNITED STATES

THE annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, Chicago, December 18, at 4 p.m.

E. W. ELLIOT, *Secretary,*
55 E. Washington St.,
Chicago, Ill.

NATIONAL ASSOCIATION OF DENTAL ANESTHETISTS

THE next meeting of the National Association of Dental Anesthetists will be held November 27 in the auditorium of the Squibb Building, New York City.

JOHN B. WOODMAN, *Chairman,*
Program and Publicity,
60 Broadway,
New York City.

DENVER DENTAL ASSOCIATION

THE Denver Dental Association will hold its thirty-third annual Rocky Mountain Midwinter Meeting, January 7-10, 1940, at the Shirley Savoy Hotel, Denver, Colo.

ALBERT P. HORTON, *Director,*
206 Metropolitan Bldg.,
Denver.

INTERNATIONAL COLLEGE OF DENTISTS U. S. A. SECTION

THE annual convocation of the U.S.A. Section of the International College of Dentists will be held at the Hotel Pennsylvania, New York City, December 3-4. The regents will meet at 10 a.m. and 2 p.m., December 3. The annual banquet will be held at 7 p.m., December 3. Headquarters will be maintained on the 17th floor through December 7. For further information and hotel reservations, address

C. RAYMOND WELLS, *Chairman,*
Arrangement Committee,
Hotel Pennsylvania,
New York City.

UNIVERSITY OF NEBRASKA COLLEGE OF DENTISTRY HOMECOMING

THE first annual University of Nebraska College of Dentistry Homecoming will be held in Lincoln, November 24-25.

A. H. SCHMIDT, *Chairman,*
Arrangements Committee,
University of Nebraska,
Lincoln.

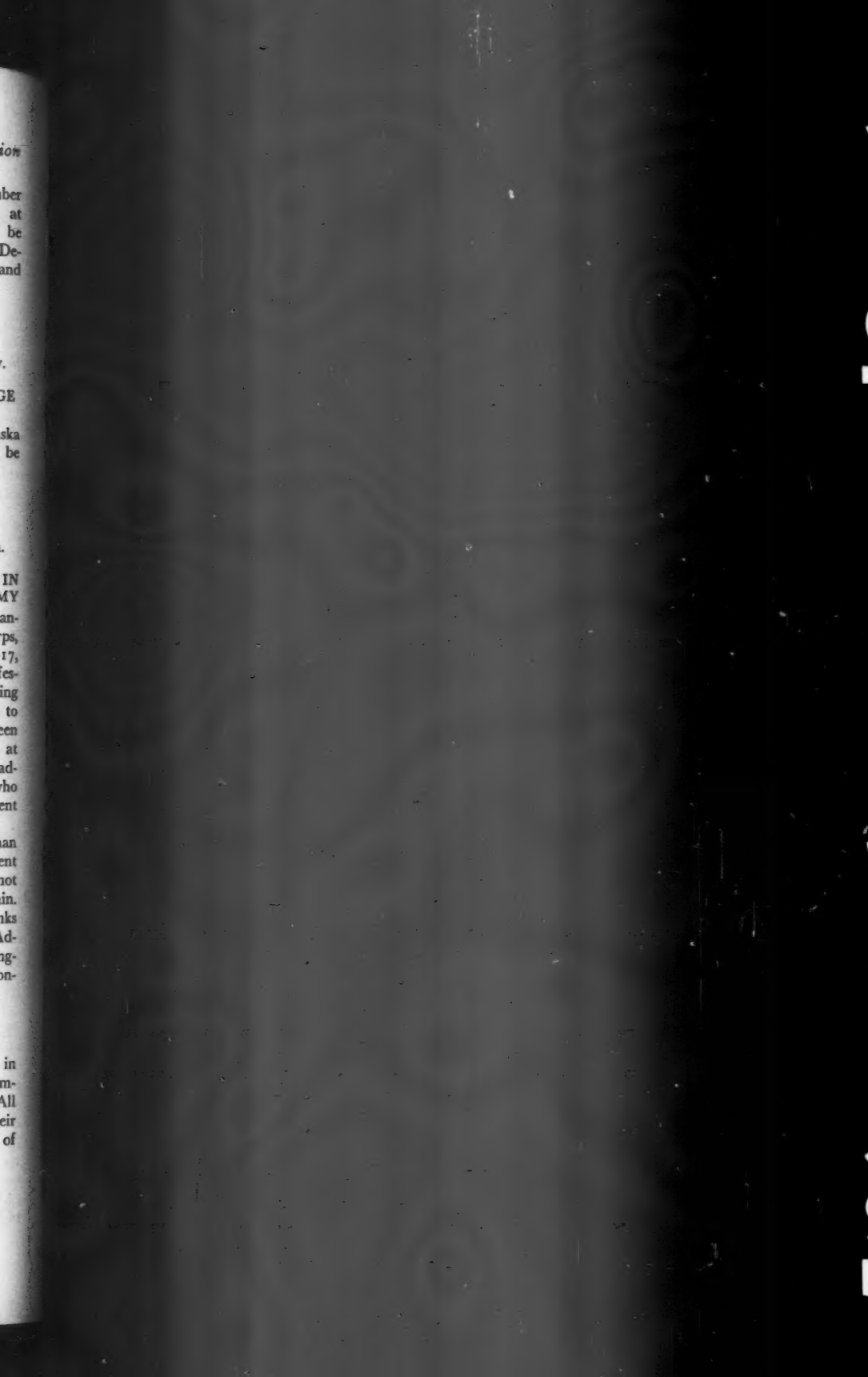
EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS, REGULAR ARMY

An examination for the selection of candidates for appointment in the Dental Corps, Regular Army, will be held February 12-17, 1940, including both physical and professional examinations. The latter, consisting of written, oral and clinical tests, is open to male citizens of the United States between the ages of 22-9/12 and 31-9/12 years at the time of the examination, who are graduates of acceptable dental schools and who have had at least 1-11/12 years subsequent practice in their profession.

Candidates who have failed in more than one previous examination for appointment in the Dental Corps, Regular Army, will not be permitted to undergo examination again.

Full information and application blanks will be furnished upon request to The Adjutant General, War Department, Washington, D. C. Applications will not be considered after January 27, 1940.

ALPHA OMEGA FRATERNITY DIRECTORY

THE Alpha Omega Fraternity is now in the process of publishing a new and complete directory of its entire membership. All fraters are hereby requested to forward their names, office addresses, year and school of graduation to

WILLIAM RICH, *Supreme Scribe,*
575 Belleville Ave.,
Belleville, N. J.